ANON

1945

THE MAINE

AGRICULTURAL EXPERIMENT STATION

ORONO

Reprint from Bulletin No. 438 June, 1945

POTATOES

General view of one of the Katahdin plots subjected to a low level of aphid population. Randomized block, population-levels experiment. Aroostook Farm, Presque Isle, Maine. September 11 or 16, 1944. W. A. Shands.

UNIVERSITY OF MAINE

ORONO, MAINE

CONTENTS

POTATOES

Potato production for seed purposes and for table stock is Maine's most important farming enterprise. The potato industry continues to have problems and the research program is aimed at solutions of the more important of these. The potato was one of the most important food crops during the war period and will continue as highly important through the reconstruction period. This is due to its capacity to produce large quantities of food per acre and to the fact that it is an important item in the diet for most peoples of the world. Maine has stood at the top on its production per acre of table-stock potatoes and on its production of good seed.

POTATO DISEASES AND INSECTS[1]

Bacterial ring rot, leafroll including net necrosis, and late blight continue as the three most serious potato diseases in Maine. There are prospects that new varieties or other means will be available for easier control of each of these within a very few years. The combination of table-stock quality with resistance to all three of these diseases, however, requires a tremendous amount of detailed work. Nevertheless, progress is being made and each year brings us closer to success.

Bacterial Ring Rot. Reiner Bonde, M. R. Harris, Donald Merriam. Until resistant varieties are available, it will be necessary to improve the other measures of control such as seed treatment, sanitary methods, and better seed plots.

Better Seed Program. Data secured from surveys show that progress is being made in combating this disease in certain areas where the farmers have made a special effort to secure disease-free seed while little or no progress is being made in other areas. It is hoped that the proposed "feeder farm" project will be a factor making available more disease-free seed which can be distributed in the communities where it is needed.

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[1] A substantial sum from the cent-a-barrel potato tax has been available for the studies on "Potato Diseases and Insects" and for the studies with "Potato Products."

Seed Piece Disinfection for Control of Ring Rot. A disinfectant is needed which will destroy the causal organism of ring rot and not injure the seed potatoes or corrode the metal parts of the machinery and equipment used in the production and marketing of the potato crop.

Puratized N5-X was tested regarding its value as a disinfectant of potato seed pieces for the control of ring rot. Solutions of this material were tested at three concentrations and for five, 30- and 90-minute treatment periods. (See Table 1[2].) This material was ineffective in reducing the amount of infection at the three concentrations and for the three periods of time under test. Furthermore, it was very toxic to the cut seed potatoes and reduced materially the stand and vigor of the plants.

Disinfectants for Killing the Ring-Rot Organism. A comparison was made of a number of different disinfectants regarding their relative ability to destroy the ring-rot organism on pieces of contaminated burlap sacks. The different bactericides were tested at different concentrations using 5-minute treatment periods. (See Table 2.) Copper sulfate, used at the rate of 1 and 2 pounds in 10 gallons of water, did not completely destroy the organism. It was completely destroyed when two pounds of copper sulfate were added to a saturated table salt solution. Table salt, however, without other disinfecting material was not effective.

Coal tar dip preparations were reasonably effective bactericides at dilutions of one and two gallons in 100 gallons of water, although a trace of infection did survive at a concentration of four gallons of tar dip in 100 gallons. Formaldehyde was not entirely effective at a concentration of one pint in 40 gallons but was effective when used at a concentration of 4 pints in 100 gallons of water. Corrosive sublimate continued to be the most effective disinfectant for destroying the ring-rot bacteria. However, this material is very corrosive to metals and expensive to use in large quantities.

Survival of Ring-Rot Bacteria under Different Storage Conditions. In February of 1943, studies were begun to determine the length of time the ring-rot bacteria can survive on contaminated potato bags when subjected to different storage conditions. Twelve-inch squares of potato burlap bags were severely contaminated with the crude ring-rot material taken from infected potatoes. One

[2] All Tables are in the Appendix, pages 565-602.

group of contaminated potato bags was hung on the north side of a farm building where it was subjected to the rigorous weather conditions that prevailed during the winter of 1943-1944. Similar pieces of contaminated bags were put into storage chambers maintained at 30, 32, and 36° F. These pieces of bags were removed after different intervals of time and used to inoculate freshly cut potato seed pieces by the seed-piece rubbing method. The seed pieces were planted in the greenhouse and in the field immediately after they had been inoculated. Ring-rot bacteria were not completely destroyed by an exposure for 483 days (approximately 1 year and 4 months) to outside weather conditions as they prevailed in Aroostook County during the winters of 1943 and 1944. (See Table 3.) The bacteria appeared to have been dead at the 36° F. temperature after storage periods of 334 and 485 days in the controlled temperature bins. The results show that the ring-rot bacteria can survive under certain conditions for long periods of time.

The data in Table 4 are from another experiment of a similar nature. Here the contaminated pieces of burlap bags were stored at 32° F. for a period of 11 months and then were used to inoculate the freshly cut potato seed pieces. Two methods were used to inoculate the seed pieces in order to test the viability of the organism. It may be noted that the bacteria survived for the 11-month period on each of the 5 pieces of bags that were tested. The amount of infection that resulted was much higher when the seed pieces were inoculated by the eye-pricking method, the percentage of infection which resulted being from 70 to 100 per cent. The percentage of infection was from 0 per cent to 50 per cent when the seed pieces were inoculated by the seed-piece rubbing method.

Survival of Ring-Rot Organism in the Soil. Previous studies conducted in Maine have indicated that the ring-rot bacteria do not survive for long periods of time in the soil. In 1944, greenhouse soil in which diseased potato plants had grown was stored in barrels in the greenhouse and outside. After a period of six months the soil was put into greenhouse pots and freshly cut potato seed pieces were planted. No ring rot appeared in 400 plants grown in this contaminated soil.

In another experiment, greenhouse soil in which plants having ring rot had been grown was contaminated further with crushed pieces of ring-rot tubers and put into pots and placed outdoors in

a sheltered location. At about three-week intervals a few of these pots were taken to the greenhouse and planted with freshly cut potato seed pieces. Thirty per cent of the plants developed ring rot when the seed pieces were planted immediately in the contaminated soil. Twenty per cent infected plants resulted when the seed pieces were planted three and six weeks after the soil was contaminated. No ring rot developed when the seed pieces were planted in the soil later than six weeks after it had been contaminated. These data support those previously secured to the effect that the ring-rot bacteria do not survive for long periods of time in unsterilized field soil.

Breeding for Resistance to Ring Rot. The tests for ring-rot resistance were continued in 1944. In one experiment eight varieties were compared regarding their relative resistance to the disease when inoculated by artificial methods. This was done to determine whether certain varieties previously selected as being resistant actually are or whether they merely had escaped.

Green Mountains and Katahdins continued to be very susceptible to infection. (See Table 5.) The Sebago variety appeared to be somewhat less susceptible and only 51 per cent of the inoculated seed pieces developed ring rot in contrast to 95 and 72 per cent respectively for the Green Mountain and Katahdin varieties. President and Seedlings 47102, 46952, 870, and 824 continued to show resistance to infection. These varieties are not immune but contract the disease less readily than do the standard varieties now being grown in Maine.

Varieties differ greatly regarding the extent to which the tubers decay as a result of ring-rot infection, those of the Green Mountain, Katahdin, and Sebago decaying very extensively when infected with the disease. The resistant varieties, however, show much less extensive decay, the tubers remaining firm and intact with only a slight amount of decomposition.

Ring-Rot Resistance in Progenies from Crosses with Resistant Varieties. The progenies from a number of crosses, using resistant parents, were tested for resistance to ring rot in the field in 1944. The data secured from these experiments are summarized in Table 6. Resistance to ring rot is inherited and a high percentage of resistant seedlings will result if resistant parents are used in making crosses. Many resistant seedlings result if the President variety and seedlings 46952 and 336-144 are used as parents. Al-

though the President and seedling 336-144 (President x Katahdin) transmit a high percentage of resistance to the progenies, they are not suitable for the production of new varieties that will be desirable for Maine. When these are used as parents (President, 336-144, and other related varieties), a high percentage of very late seedlings with ill-shaped tubers is produced. Seedlings 46952 and 47102 transmit ring-rot resistance and also produce progenies that possess good cooking and marketing qualities. It now seems that it will be possible to produce and select new varieties that are resistant to ring rot and commercially desirable.

Ring-Rot Survey. Prior to 1944, two ring-rot surveys had been made in several localities in the State. In the 1941 survey most of the farms in each area were inspected. Seventy-two per cent of the farms examined in three towns were infected with ring rot. Forty-one per cent of the total acreage was infected. In one town 67 per cent of the farms, 34.5 per cent of the fields, and 40.9 per cent of the total acreage showed a trace or more of ring rot. In 1943, a second survey was made of this town. The ring-rot infestation had been reduced to some extent although it was present on 41 per cent of the farms, 30 per cent of the fields, and 27 per cent of the acreage.

In the 1944 survey, 62 farms selected at random in this same town were visited. Of these, ring rot was found on 19 farms, very largely as a mere trace in the fields. There was a total of 1,513 acres inspected, made up of 80 fields. Two hundred and seventy-eight acres in 19 fields were infected with ring rot. (See Table 7.) On a basis of infected fields the percentages for the three years were 35.4, 29.7, and 23.7, respectively. On an acreage basis the percentages were 40.9, 27.2, and 17.9 for the three years. These data show that much progress has been made in reducing the amount of ring rot in this town. It now appears in few fields and in these very largely as a trace only.

From time to time growers and others have expressed themselves as believing that one variety or another is especially susceptible to the ring-rot disease. Data for the year 1944 from one town tend to show that there was a wide variation in the percentages of disease in the various varieties. (See Table 8.) Katahdins made up 13.2 per cent of the diseased acreage. This is considerably less than 33.9 per cent which was diseased in 1941, or 32.7 per cent which had ring rot in 1943. By way of contrast, the Houma variety

was free of disease in 1941, rose to 15.6 per cent diseased in 1943, and to 33.3 per cent in 1944, but these data were taken on a relatively small acreage. It will be noted that the Green Mountain variety, like the Katahdin, fell rather sharply in the amount of ring-rot infection from 1941 to 1944. The Irish Cobbler and Sebago varieties were diseased in 1941 but were free of ring rot in 1944. These data suggest that there is little ground for the belief that any one potato variety of those grown at present is more susceptible than others to the ring-rot disease.

Severity of Ring-Rot Infection. The percentage of ring rot found in the fields of one town for the years 1943 and 1944 has been summarized in Table 9. In 1943, 67.5 per cent of the infected acreage was showing only a trace of the ring-rot disease. In 1944, this figure was raised to 74.5 per cent. In 1943, the infected acreage was 27.2 per cent of the total surveyed and in 1944 it was 18.4 per cent of the total acreage surveyed. The disease in 1943 was characterized as severe on only 22 acres out of 2,486 acres examined. In 1944, none of the acreage out of 1,513 acres examined could be classified as being severely infected by the disease.

Seed Sources. It is interesting to note that in one town surveyed the source of the potato seed stock may have been the means of spreading ring rot in that area. Table 10 shows that seed for 4 of the 19 infected fields surveyed came from one seed source which was known to be infected. Two other seed sources each provided seed for two infected fields. These eight fields made up nearly 45 per cent of the infected acreage surveyed in this town. Thus it is clear that a few contaminated seed sources can be the means of spreading the ring-rot disease over extensive areas.

Farm Security Administration Seed Plots. In cooperation with the Federal Farm Security Administration 34 growers having seed plots were interviewed and bin inspections made where possible. Each of these growers purchased a small amount of seed which was free of ring rot and much of it had been certified by the Maine Seed Certification Service. This seed was used to plant a seed plot from which enough seed potatoes would be produced to supply the grower's needs for his commercial crop the following year. Each grower was given instructions by the Farm Security Administration personnel as to the method of handling the certified seed used to plant the seed plot. The planter, digger, tools, barrels, and bins used in growing and storing these seed plot potatoes were to be

either new or sterilized. In addition, the growers were advised to plant and harvest the seed plot before handling any commercial potatoes. The growers followed this advice to some extent as indicated in the data shown in Table 11.

Of the 34 growers who produced their own seed under the Farm Security Administration program, 27 were found to have grown seed believed to be free of ring rot. There were 7 who were known to be unsuccessful in eliminating ring rot from their seed plots. By way of contrast, 27 of these growers had ring rot in their commercial fields and only 7 were entirely free of the disease. (See Table 12.)

From the above data it would appear that the method of securing a small amount of certified seed to be increased on a seed plot offers possibilities of enabling a grower to eliminate ring rot from his farm.

LEAFROLL INCLUDING NET NECROSIS. ***Resistant Varieties.***[3] HIGHMOOR FARM TESTS. Donald Folsom. Seedlings have been introduced to Highmoor Farm since 1938 in tests for field resistance to leafroll. Survivals on the basis of resistance and of tuber type are given below.

Year of introduction and number of seedlings introduced		Still apparently healthy in 1943 and replanted in 1944	Leafroll in 1944
1938	776	None	—
1939	1422	18	0
1940	1120	6	1
1941	2200	21	19
1942	1273	171	136
1943	1795	1530	834
1944	2022	—	—

Actually, of the 18 introduced in 1939 and remaining in the test in 1943, all but one have shown some leafroll, but the average percentage of leafroll taken per year for the last three years has been 4 per cent while healthy Chippewas and Green Mountains

[3] The potato breeding program is cooperative with the Bureau of Plant Industry, Soils, and Agricultural Engineering of the U. S. Department of Agriculture. Grateful acknowledgment is made to Doctor H. A. Jones, Doctor F. J. Stevenson, and Robert Akeley who are the Bureau representatives on this study in Maine.

have taken an average of 85 per cent and 50 per cent per year respectively.

The 1,795 seedlings introduced in 1943 were all with one or both parents from the resistant seedlings surviving from the 1939 introductions. The reduction from the 1,795 to the 1,530 planted in 1944 was due to discarding 265 for poor tuber type in the fall of 1943. Some of the crosses of this group went only about 35 per cent leafroll while others went 75 per cent, with no correlation with order of planting or location in plot in the year of exposure, 1943.

This apparently greater resistance of the seedlings introduced in 1943 was accompanied by greater vigor and better tuber type attributable to their parentage (seedling and commercial varieties). The results indicate that faster progress can now be made in getting new seedlings that are leafroll-resistant and commercially desirable. Most of the resistant seedlings from those introduced in 1939 were from the cross Imperia x Earlaine, parent varieties not considered highly desirable commercially. However, the few remaining resistant seedlings of the early introductions are being used as parents in crosses with good commercial varieties and with seedlings that are resistant to other diseases.

Comparison of Leafroll-Resistant Seedlings. Donald Folsom, F. H. Steinmetz. Some of the seedlings that showed field resistance to leafroll at Highmoor Farm were discarded on account of obviously undesirable characteristics such as premature production of sprouts, too many stalks per hill, weak vines, too early maturity, leaf rolling, highly undesirable tuber skin, highly undesirable tuber shape, and too many and therefore too small tubers. Conditions were not suitable at Highmoor Farm for judging yielding capacity. Eighteen seedlings, exposed from 1939 or 1940 to 1943 and still practically free of leafroll, were planted in a series of plots on Aroostook Farm with Green Mountain checks. Seed pieces were cut to 1.5 to 2 ounces each. See Table 13 for data on vines and tubers.

Correlations were tested between certain characteristics including some of those listed in Table 13. (See Table 14.) Among the various seedlings, the more stems there were per hill the more tubers there were per hill, and the larger the number of stems or the more the number of tubers per hill the less the tubers averaged in weight and the greater was the yield per hill. Then, the greater

the yield per hill the more plants there were per plot, and each of these apparently resulted in more yield per acre. The seedlings varied much from inherent causes, some proving undesirable because of too many stems per hill and a consequent excess of small tubers. This fault was absent from X1276-48 and X1276-185; the latter yielded well and the former might have if the seed had been treated for Rhizoctonia.

Resistance of Selected Potato Seedlings to the Aphid-Borne Leafroll Virus. Reiner Bonde, Geddes W. Simpson. A number of seedling potatoes were secured in 1944 from the United States Department of Agriculture for testing for resistance to leafroll transmitted by infected individuals of *Myzus persicae* (the peach aphid) transferred manually from leafroll plants to the seedlings. Seedling progenies from seven crosses were included in the test. First-year tubers produced by plants grown from true seed in a greenhouse at Beltsville were planted at Aroostook Farm, May 23, 1944. Specimens of the peach aphid from a greenhouse culture were transferred to young cabbage plants and allowed to increase. Late in June, transfers were made to half-grown leafroll Katahdin plants in 6-inch pots. After a period of at least 10 days had elapsed, the Katahdin plants were transported to the field where leaves, leaflets, or parts of leaflets were detached and placed on the seedling potato plants. The amount of leaf tissue used in each case was determined by the number of aphids present. A minimum of five adult peach aphids was used for inoculating each seedling. In many cases, immature aphids were present also on the transferred leaf tissue.

The first transfer was made on July 8, 1944 and subsequent days. Unfortunately, not all of the plants were through the ground by this date so that only the more advanced plants in each cross could be inoculated at this time. The remaining plants were inoculated at intervals until the work was completed in mid-August. Some of the later inoculations were made by taking naturally infested leaves from leafroll plants growing in the field.

Current season leafroll symptoms became evident in the earliest inoculation within 15 to 25 days of the time the virus was introduced. It was less evident in the later inoculations. The entire planting was examined critically in September for current season symptoms of leafroll. Each plant that did not show

symptoms of leafroll was marked for harvesting and is to be replanted in 1945 to determine the incidence of leafroll in those plants not showing current season symptoms. It is expected that there will be some escapes in this group as the aphids used are, of course, subject to attacks of parasites and predators and it cannot always be proved that the infestation found on a given plant arose from the few aphids transferred earlier. The tubers produced by many of the plants showing current season leafroll were saved and will be stored under conditions favoring the development of net necrosis and will be examined for this condition.

The results of the season's work are presented in Table 15. It should be emphasized that the tubers saved for further testing do not necessarily represent resistant sorts. They may be escapes, they may have leafroll but have failed to show current season symptoms, or they may actually be resistant to leafroll.

Effect of Fertilizer on Net Necrosis Development. PERMANENT PLOTS. Joseph A. Chucka, Arthur Hawkins. Tuber samples taken from the permanent plots in 1944 and examined for the development of net necrosis showed about the same effects from fertilizer treatments as were observed in previous years. The net necrosis readings were somewhat higher in 1944 than in previous years and were not as closely associated with fertilizer treatments as was stem-end browning. (See Table 16.)

FERTILIZER TESTS ON NEW LAND. Many of the fertilizer treatments on the permanent plots have been repeated on the same land for as many as 18 years. Thus the data on net necrosis obtained from these plots should be the result of the residual effect of fertilizer treatments in so far as fertilizers are a factor. To measure the more immediate effect of certain treatments on the development of net necrosis, an experiment was laid out on a piece of land on Aroostook Farm which had not been previously fertilized. The fertilizer treatments used included several rates of application (none, 2500, and 3500 pounds per acre). They included fertilizer without potash and with potash from three different sources and they included treatments with and without added chlorine, boron, and copper. The effect of these treatments on potato yields and on the development of stem-end browning and net necrosis is shown in Table 17. None of the treatments used produced potatoes that were free from net necrosis. In fact the percentages of net necrosis developed in the tubers grown

on this new land were nearly as high as those obtained from the permanent plots.

BORON IN POTATO FERTILIZERS. Several levels of boron in the form of borax, spent boron catalyst, and boron silicate glass were added to potato fertilizers to study their effect on the development of net necrosis. These materials apparently had little or no effect on net necrosis. They offer no possibility as a corrective measure because they are extremely toxic to the potato plants. Their use resulted in yield reductions all the way from 14 to 73 barrels per acre. (See Tables 18 and 19.)

Effect of Planting Date on Net Necrosis. A. Frank Ross. Two strains of Green Mountains were planted at three different dates at Aroostook Farm. Samples were dug from each planting at three different dates, stored at 50° F. and examined for net necrosis 100 or more days after digging. The results are shown in Table 20. In all cases those planted on May 15 were comparatively low in net necrosis, those planted June 1 were considerably higher and except for the late dug samples, those planted June 15 were still higher. Since the tubers were stored at a temperature optimum for the development of net necrosis, the figures represent the maximum to be expected. In farm or commercial storage they might be uniformly lower in net necrosis, depending upon how soon after digging the storage temperature dropped to below 50° F.

The data from 13 other plots are summarized from the standpoint of date of planting. (See Table 21.) All other factors, such as treatment, location, digging date, seed, etc., were ignored and all plots classified in regard to planting date. Here again, early planting resulted in considerably less net necrosis. Hence, in 1944, the date of planting was one of the most important factors affecting the amount of net necrosis in the crop. This is in agreement with earlier experience that there is usually less spread of leafroll in early planted potatoes.

These data suggest that early planting of Green Mountains may go far in helping to control net necrosis. It is recommended, therefore, that growers of Green Mountains plant this variety first, that is, before other varieties are planted. This is true for both seed growers and table-stock growers. The data also suggest that one reason why net necrosis has been more troublesome in

recent years is that, due to an expanded acreage program, planting is often continued well into June.

Effect of Digging Date on Net Necrosis. A. Frank Ross. Some information was obtained in respect to the effect of date of digging on net necrosis in 1944. (See Tables 20 and 25.) In general, the amount of net necrosis increased with later digging dates up to about October 1, but after that date there appeared to be a decrease in the amount of net necrosis obtained.

Selection for Resistance to Net Necrosis. A. Frank Ross. All Green Mountain tuber lines so far investigated are equally susceptible to net necrosis. There was no correlation between the behavior of a tuber line the past two years and the amount of net necrosis developed in 1944. On two plots (Tables 20 and 26), the Keswick strain developed more net necrosis than the Minnesota lot. The difference was more pronounced when the tubers were dug early. The data are insufficient to conclude that the former is more susceptible to net necrosis. Small differences in the amount of leafroll in the seed might account for the differences. On other plots the two strains produced the same amount of net necrosis.

Effect of Minor Elements on Net Necrosis. A. Frank Ross, Arthur Hawkins (U.S.D.A.), Joseph A. Chucka. Work was continued on the effect of minor elements, added to fertilizer or applied as a spray, on the development of net necrosis. This year bromine, chromium, strontium, cobalt, vanadium, yttrium, lanthanum, cerium, neodymium, thorium, uranium, rubidium, and cesium were tested. All were without any appreciable effect on net necrosis development. Results from the 1943 season with chromium salts could not be substantiated. In addition, two commercial products, Es-Min-El and Milorganite, both reported to contain several minor elements, were without effect on net necrosis. (See Tables 28 and 29.)

Fertilizer and Spread of Leafroll. A. Frank Ross, Joseph A. Chucka. Samples from the permanent plots were again planted for leafroll readings. (See Table 23.) Results in general agree with those of previous years. Increased amounts of fertilizer resulted in an increase in the spread of leafroll virus, increased net necrosis, and increased the net necrosis : leafroll ratio. This seems to be due chiefly to the amount of phosphorus applied, because a direct correlation was also obtained between the amount of phosphorus applied and the spread of leafroll, the amount of net necrosis and the net necrosis : leafroll ratio. In the nitrogen

series, the greatest amount of net necrosis and the greatest spread of leafroll were obtained when from 40 to 80 pounds of P_2O_5 per acre were applied. The net necrosis: leafroll ratio decreased with increasing amounts of nitrogen. In the potassium series, the greatest spread of leafroll resulted from the application of 40 pounds of K_2O per acre. Larger amounts decreased both the spread of leafroll and the amount of net necrosis. The net necrosis: leafroll ratio was not affected by the higher amounts of K_2O. The C.P. plots were slightly lower on all three counts than for corresponding applications of commercial fertilizer. Substitution of the sulfate for the chloride as the potash carrier reduced the amount of net necrosis, the spread of leafroll and the net necrosis: leafroll ratio. The data from the permanent plots for three years indicate that the continued application of large amounts of P_2O_5 favors the spread of leafroll and likewise increases the net necrosis: leafroll ratio. The presence of high amounts of chloride in the fertilizer also tends to increase these two factors.

APHIDS AFFECTING POTATOES IN MAINE.[4] Geddes W. Simpson, Wayland A. Shands. ***Wild and Cultivated Host Plants as Sources of Aphid Infestation in Potatoes.*** SECONDARY HOSTS. *Biennial weeds as overwintering hosts of wingless aphids.* Observations made at frequent intervals during the early part of the season, failed to disclose overwintering of the summer forms of aphids on any of several species of biennial weeds. The observations were made before the winged forms of those species of aphids affecting potatoes[5] had matured on their primary hosts.

Importance of Weeds as Aphid Hosts. Further studies in 1944 were made to determine the importance of seven species of weeds[6] as hosts of several species of aphids.

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[4] The studies with aphids affecting potatoes and their control are made in cooperation with the Bureau of Entomology and Plant Quarantine of the Agricultural Research Administration of the U. S. Department of Agriculture. W. A. Shands and T. E. Bronson are the Bureau representatives working on these problems in Maine.

[5] The buckthorn aphid, *Aphis abbreviata* Patch; the green peach aphid, *Myzus persicae* (Sulz.); the potato aphid, *Macrosiphum solanifolii* (Ashm.); and the foxglove aphid, *Myzus pseudosolani* (Theob.).

[6] Wild radish, *Raphanus raphanistrum* L.; wild rutabaga, *Brassica campestris* L.; smartweed, *Polygonum lapathifolium* L.; hemp nettle, *Galeopsis tetrahit* L.; lamb's-quarters, *Chenopodium album* L.; field sorrel, *Rumex acetosella* L.; and ox-eye daisy, *Chrysanthemum leucanthemum* L. Locally, wild radish is known as kale and wild rutabaga as mustard.

The relative importance of five species of weeds in both 1943 and 1944 is shown in Table 30. Two other weeds, field sorrel and ox-eye daisy, were of no importance either year, although in 1942 they were important hosts of the buckthorn aphid.

In a large measure the results for the two years agree rather closely. The differences shown may have been influenced by several factors. The weeds were colonized by aphids earlier in 1944 than in 1943. The 1944 season in general was much more favorable for rapid, continued reproduction of the aphids since it was somewhat drier during most of the season. Fungus diseases did not kill the aphids until later than in 1943. In general, the initial aphid populations on the weeds in 1944 consisted largely of the green peach aphid and the potato aphid, while in 1943 the potato aphid and the buckthorn aphid were the first to appear. Finally, two species of weeds (wild rutabaga and lamb's-quarters) were not so abundant in the stands of some age groups in 1944 as they were in 1943, and were therefore not available for sampling throughout their entire productive lives; consequently Table 30 shows the relative importance of each weed only as it relates to a stand of weeds having the particular compositions encountered.

Results of these studies indicate rather clearly that the weeds may serve as important hosts intermediate between the overwintering hosts and potatoes, particularly for the green peach aphid. This has been suspected since 1942, but it was not until 1944 that an opportunity was afforded to obtain field data of a clear-cut nature upon the subject.

Relative Importance of Weed Hosts Growing in Competition with Agricultural Crops. Aphid-population counts were made about once a week from late in June until early in August on several species of weeds occurring in agricultural crops to ascertain the importance of these weeds as host plants when growing in different environments. The study involved wild radish, wild rutabaga, wild turnip, smartweed, hemp nettle, and lamb's-quarters when growing in fields of potatoes, oats, crimson clover, mammoth clover, and English peas. As in previous studies in 1942 and 1943, it was found that the weeds were more important as aphid hosts (from the standpoint of total aphid production) when growing in fields of potatoes and annual clovers than when in fields of oats and English peas. Weeds growing in oats, however, as well as in potatoes and annual clovers may be of outstanding importance as

intermediate hosts of the aphids. Wild rutabaga appeared to function as an intermediate host in the potatoes and the oats, and wild radish in crimson clover and mammoth clover.

Potato as a Host of Aphids. Flight studies indicated that weeds and potatoes that had appeared above ground could have been infested by aphids as early as June 7 in 1944; however, practically no potatoes had emerged by then. June 28 was the date when the first aphids were actually observed on potatoes. This is slightly later than in 1942 and 1943, partly because potatoes were later in emerging in 1944. Winged aphids maturing on early potatoes were first found July 27; on weeds growing in potatoes on June 28, in mammoth clover and crimson clover on June 30; in oats on July 3; and in wasteland on July 12. Inasmuch as the potatoes were late in emerging and held only small populations of aphids until well into the summer, there is little question that their initial populations were winged aphids, particularly so in the case of the green peach aphid which developed on weeds.

Aphid-population trends were followed rather closely in four fields of potatoes near Presque Isle by making weekly counts during much of the season. A general comparison of the data with those obtained during 1942 and 1943 indicates that the relative abundance of the several species of aphids varied markedly from year to year and between fields during any one of the years, and that there were also differences from year to year in the first date on which 100 per cent of the plants were found to be infested, and in the overall intensity of the infestation.

In general, the buckthorn aphid was most abundant in 1942, followed by the green peach aphid and the potato aphid; in 1943 the potato aphid was more abundant and the green peach aphid was almost absent, and the buckthorn aphid was abundant in some fields but practically absent in others; and in 1944 the green peach aphid was by far the most abundant in most fields, followed by the potato aphid. The 1944 population trend for the buckthorn aphid resembled that indicated for 1943. Including the buckthorn aphid, the heaviest infestation of aphids was in 1942, followed by 1944 and 1943, but when that species was excluded the rank was 1944, 1942, 1943. The approximate dates when all potato plants were found to be infested by aphids were July 15, 1942, August 15, 1943, and July 30, 1944. The composition of the aphid population varied largely from field to field each year.

Population counts of aphids infesting several varieties of potatoes, planted in small plots in one field, were begun in an effort to determine whether varietal differences exist in respect to suitability as hosts for the several species of aphids under field-growing conditions. The study had to be discontinued in mid-August when heavy infestations developed, but indications of value were obtained. The varieties Irish Cobbler and Green Mountain were considerably more productive of the buckthorn aphid than were the others. Chippewa, Irish Cobbler, Katahdin, and Sebago were much more productive of the green peach aphid than were Green Mountain or Mohawk. There was little varietal difference in respect to the potato aphid, although the largest numbers were found on Irish Cobbler, and the smallest on Chippewa. Infestations of the foxglove aphid were too low to indicate any varietal differences.

Effects on Potatoes of Different Aphid Populations and of Different Percentages of the Seed Pieces Planted Having Leafroll. Different aphid populations were maintained on replicated small plots of potatoes growing in one field, as shown in Tables 31 and 32. Three levels were maintained and an added factor of leafroll disease was included to test the effect of disease level upon disease spread. The variety planted in all plots was Katahdin.

Fairly good success was obtained in maintaining the desired populations of the green peach aphid and the potato aphid, particularly the former, inasmuch as it was the more abundant. Relatively few specimens of the buckthorn and foxglove aphids were present. The general appearance of the plants, the prevalence of honeydew on the plants, and of discolored veins, and the order in which the plants died in the fall seemed to be closely and positively correlated with the level of aphid population. From the standpoint of U. S. No. 1 tubers produced, the low-level plots (fewest aphids) yielded 41.3 per cent more than the high-level plots, and the intermediate-level plots 13 per cent more. Both increases were highly significant. The tuber samples taken for readings as to current spread of leafroll are in storage and will be planted in 1945.

Flight Habits and Environmental Factors Influencing Aphid Spread. A seasonal record of aphid flight was obtained for the third consecutive year in several locations near Presque Isle. The average number of aphids per trap taken in 1944 was between that

in 1942 (higher) and 1943 (lower). In 1942 the catch consisted chiefly of the buckthorn aphid, while in 1944 the green peach aphid was more abundant. The flight season of 1944 ended earlier than in the two previous years, owing to a severe outbreak of fungus diseases which about September 8 to 12 attacked the aphids infesting potatoes.

Natural Agencies of Aphids. PARASITES AND PREDATORS. Records made while determining aphid populations on weeds growing in wasteland showed that parasitized aphids first were present in appreciable numbers about August 5-8 and that they were most numerous about August 15-21. On the last date as high as 35 per cent of the aphids found on one species of weed were parasitized. Although fungus diseases had severely reduced the aphid populations on weeds by September 5-8, at that time on one species of weed approximately 90 per cent of those aphids which had not been killed by fungi were parasitized. As might be expected, the parasites did not become abundant before large aphid populations were on the weeds and potatoes, or after large numbers of alatae had matured on the weeds and flown to potatoes.

DISEASES. Fungus diseases (principally *Empusa aphidis*), while late in getting started, virtually eliminated the aphid population on all summer hosts by mid-September. Although the action of fungi on aphids infesting potatoes near Presque Isle first began to appear about September 8, they had been attacking aphids infesting weeds of a certain age since early in August. The weeds on which aphids were first affected germinated after the last hilling operation in potatoes. The aphids on those germinating after the second or next to the last hilling were not affected by the fungi until about August 20. By early September, before the fungi began to attack aphids infesting potatoes, the aphid population on weeds had been reduced by disease and parasites to a very low level.

The action of fungi on the aphids in 1944 may have a very marked effect upon the early-season aphid infestation in 1945. Ordinarily the fungus diseases reduce aphid populations on summer hosts about mid-August, leaving aphid populations ample time to recover. In 1944, however, few of the aphids on potatoes at that time of the season were affected until about September 8, and since the diseases nearly eliminated the aphids on summer hosts, there was little chance for the production of male winged forms

that could move to the primary hosts for fertilizing the progeny of such females as had flown there before September 8. The green peach aphid began its fall migration about August 28. Male winged forms of this species began to mature about August 29. It appears likely that few of the fall females developing on wild plum were mature before the production and flight of males was virtually eliminated. The fall egg count on wild plum was much lower than in the previous two years.

WEATHER. Weather was an important factor influencing the abundance of the aphids and their damage to potatoes in 1944, both directly and indirectly. High temperatures in late April and early May favored an early hatching of eggs, and temperatures during late May and early June permitted a fairly rapid development of the aphids on primary hosts. However, the weather was not very favorable for the spring migrations of the green peach and potato aphids, especially during the peak of their emergence. The number of the spring migrants was considerably smaller than was indicated by the abundance of curled leaves on wild plums where they had developed.

Winter Carry-Over Hosts of the Aphids and Their Relative Abundance. THE BUCKTHORN APHID. Recently hatched eggs and young nymphs of the buckthorn aphid were observed near Presque Isle on May 5, and on May 11 young nymphs of this aphid were present inside the unfolding buds. The fall migration began about August 18, and on September 6 approximately 5 to 6 eggs per 100 buds were found on buckthorn near Presque Isle. Examination of fall migrants taken in aphid traps disclosed the presence of male winged forms by August 16.

THE GREEN PEACH APHID. Aphid eggs surviving the winter on wild plum were far more numerous in the spring of 1944 than in 1943. The first nymphs of the green peach aphid were found May 3 and 4 on plums growing out of doors. Practically all aphid eggs on wild plum near Presque Isle had hatched by May 9.

The first mature winged forms of this aphid on wild plum near Presque Isle were observed on May 31, but maturation of the spring migrants reached a peak between June 11 and 26 and ended about July 2. The dates were between two and three weeks earlier than in 1943.

The fall migration began about August 28, a few days later than in the previous three years. Relatively few eggs were de-

posited on wild plums despite the fact that the largest fall populations yet seen on this plant were present. Aphid eggs were first observed on wild plum near Presque Isle on October 4.

THE POTATO APHID. Young nymphs were first observed on wild rose near Benedicta on May 1, and near Presque Isle on May 5. The first mature stem mother at Presque Isle was collected on May 12 on rose. A similar collection was made at this place on May 12 in 1942 and on May 25 in 1943. The spring migratory forms matured largely between June 1 and July 7, with the peak of maturation about June 20 to 23. The period of maturation in 1943 was June 19 to 30.

THE FOXGLOVE APHID. Winged and young wingless forms of the foxglove aphid were observed on June 28. The insect was rather generally present over north-central and central Aroostook, in the vicinities of Lee and Prentiss, and northwest of Bangor. The aphid was absent in northern Aroostook and in the western part of the central Maine potato area, and practically absent in southern Aroostook.

ABUNDANCE OF APHID EGGS ON OVERWINTERING HOSTS. Aphid eggs were much more numerous on wild plum and buckthorn in the spring of 1944 than in 1943, but perhaps somewhat less numerous on wild roses. Eggs were far less abundant on the parts of the wild plum and rose plants, from which samples were drawn, in the fall of 1944 than at the same time in 1943, and considerably less abundant on buckthorn.

WILD CHERRIES A PRIMARY HOST OF GREEN PEACH APHID. Observations during the fall over a period of years at Presque Isle have shown that moderate to heavy populations of the green peach aphid are found on two species of wild cherries commonly occurring in northeastern Maine, *Prunus virginiana* and *P. pennsylvanica*. Colonies of this aphid were never found on them in the spring. It is known that wild cherries serve as a primary host of the aphid in some parts of the United States.

Insecticidal Control of Aphids. Theo E. Bronson. Investigations on the control of the four species of aphids infesting potatoes in Aroostook County were commenced in 1940 and have been carried out each year since 1940. The potato-growing season of 1944 was relatively dry. In 1944 aphid populations on potatoes were low until late in July. (See Table 33.) By early August high

populations were present in most of the fields. The green peach aphid was the predominant species in 1944.

Aphid Control on Seed Potatoes. An experiment was conducted in four fields in which potatoes were grown for seed. Isolated fields were chosen to reduce the possibility of infection from disease-carrying migrants.

Part of each field was treated with a mixture containing ground derris root and part left untreated as a check. When suitable development had occurred, the vines in part of each field were either pulled or killed by spraying. Tubers from vines so treated were harvested earlier than tubers from vines which had not been destroyed.

At three farms ground derris root was employed in a dust mixture and at the fourth farm in a spray. From three to four applications of the insecticide, combined with a fungicide, were made.

The aphid population in all four fields was small until after the third application of insecticides. By this time it had markedly increased and the degree of aphid control obtained with the fourth application was much higher than that obtained previously. The yield of seed potatoes varied greatly from farm to farm. On all farms the treated potatoes outyielded the checks 13 to 24 per cent. (See Table 34.) This increase in yield is much more important where seed potatoes are concerned than it would be with table stock.

Sample tubers taken from early- and late-harvest plots at the four farms were planted in Florida, and the amount of leafroll appearing in new-generation foliage was determined. In all instances a greater amount of leafroll appeared in early-harvest potatoes from plots in which the vines were killed than from those in which the vines were pulled. On an average there was much more leafroll in the potatoes from treated plots than in those from the checks. (See Table 35.)

Insecticide Tests on Small Plots. In a comparison of insecticides, two strengths of DDT (10 and 3 per cent) and 0.75 per cent of rotenone were applied five times to small plots with a hand duster, each treatment being replicated six times. Although all of the mixtures applied were slow in killing the aphids, especially the potato aphid, all treated plots differed markedly in appearance from the checks—a difference much greater than was reflected in the moderate degree of control as determined from a single count.

Analysis disclosed that the tuber yield of plots treated with the mixture containing 10 per cent DDT was significantly higher than that of the plots receiving the other two treatments. (See Table 36.)

Methods of Eradicating Aphid Host Plants. George P. Steinbauer, Ferdinand H. Steinmetz. The principal overwintering aphid host plants are the wild plum, *Prunus nigra* Ait., dwarf buckthorn, *Rhamnus alnifolia* L'Her., and species of wild rose. The more important herbaceous weeds that serve as intermediate hosts between the winter host plants and the potato plants are wild radish, *Raphanus Raphanistrum* L., wild rutabaga, *Brassica campestris* L., and hemp nettle, *Galeopsis tetrahit* L.

Experiments started in 1943 to compare methods of eradicating these host plants were continued in 1944. The wild plum, dwarf buckthorn, and wild rose were eliminated by use of herbicide sprays such as ammonium sulfamate. The soil beneath these treated plants was surface-sterilized with borax or granular sodium chlorate to prevent seedlings from germinating from the fruits which were not affected by the herbicide sprays. If surface sterilization is not practiced then the herbicide spray should be used in succeeding seasons as long as sprouts or seedlings reappear. Large specimens of wild plum can be killed by inserting certain chemicals such as blue vitriol, sodium arsenite, ammonium sulfamate and ammonium thiocyanate into holes drilled into the trunks.

Greenhouse and field experiments indicate that annual weeds can be eradicated from grain fields by use of selective weed killers such as copper sulfate, cyanamid dust and Sinox. Time of application of the sprays was especially important in determining effectiveness of the treatments. The sprays were most effective when applied while the weeds were small, preferably in the 3 to 6 leaf stage. The effectiveness of the Sinox spray was less dependent upon weather conditions and size of weeds than was the case with the other two herbicides. Clover seeded with grain was severely damaged by the weed killers, especially by Sinox. Some preliminary experiments indicate that it may be feasible to plant the clover after the herbicide has been used, either through use of broadcast seeding or use of a machine seeder. While the grain plants appear injured, their recovery is rapid, especially if the application is made while they are small. Where weed infestations are heavy the elimination

of weeds may lead to sufficient increase in yield of grain to more than cover the cost of chemicals.

Because of the ability of weed seeds to remain ungerminated in the soil for several seasons, the use of herbicides for a single season will not prevent the weeds from reappearing the following year. However, their use may be considered an effective part of the weed control program, particularly where the weeds are difficult to remove, as in grain, and where infestations are heavy.

Herbicides for Killing Potato Vines. George P. Steinbauer. Although maximum yields of potatoes are obtained when the vines are allowed to mature, there are certain conditions under which it may be advantageous to terminate growth by removing or killing the vines. This may be desirable for early harvesting either to prevent leafroll infection or to control the size of tubers and as a frost substitute in late harvest.

A wide variety of organic and inorganic chemical sprays and dusts were studied in 1943 and 1944 with respect to their suitability for vine killing, along with a study of methods of applying them. Results of these experiments may be summarized as follows:

1. HERBICIDES VARY IN RATE OF VINE KILLING. Dilute sulfuric acid, 5-10 per cent in strength, is the most rapid killing agent yet studied. This chemical is used extensively in Great Britain for "burning off" potato vines for blight control or improving quality of seed. Its use in this country awaits perfection of spray machinery which will resist its corrosive action. Because of its tendency to burn clothing, particularly cotton, and flesh, it can be safely handled only by experienced workmen. Sinox (2 gallons of concentrate to 100 gallons of water, to which is added 10 pounds of previously dissolved sulfate of ammonia) and Dowspray "66" (12 pounds to 100 gallons of water, to which is added 1 pound of previously dissolved sulfate of ammonia) are fairly satisfactory from the standpoint of rate of killing. More rapid killing would be desirable for early harvesting. Other herbicides such as copper sulfate are too variable to be depended upon. Dusts as a group have not proven as satisfactory under Maine conditions as sprays.

2. RATE OF VINE KILLING VARIES WITH WEATHER CONDITIONS AND VARIETY. Certain varieties, such as the Sebago, are more difficult to kill than others. Plants making rapid growth, when there is an abundance of soil moisture and moderately high

temperatures, are more readily killed than when they are toughened by low soil moisture or low temperature.

3. COMPLETE COVERAGE OF FOLIAGE WITH HERBICIDE SPRAYS ESSENTIAL. Since the vine killing herbicides are essentially of the contact type, killing will occur primarily on those parts of the plant covered with spray. *A surprisingly large proportion of the spray rigs do not produce complete spray coverage late in the season.* Two nozzles per row and three nozzles per row spray booms were designed to cover plants in rows and early in the season they usually produce good spray coverage. However, late in the season vines may form a continuous mass of foliage from one row to another and some are not covered. None of the vine killers in use will kill foliage that is not covered with spray. Spray rigs with three nozzles per row can usually be adjusted so as to give satisfactory coverage with vine killing agents. Two nozzles per row booms are more difficult to work with. A uniform height boom, with nozzles equipped with fan disks and spaced about 13 inches apart, such as used for applying herbicides in control of weeds in grain fields is better than most two and three nozzles per row booms now in use.

4. HERBICIDE ABSORPTION BY TUBERS IS A FACTOR TO CONSIDER. Sulfuric acid, Sinox, Dowspray "66," and in fact most of the herbicides used for vine killing are of the contact type and are thought to kill only the tissues actually covered with spray. However, a few growers reported that in some 1944 applications of Sinox there was evidence of Sinox injury to tubers. Such tubers showed yellowish discoloration of the xylem vessels, which was of non-bacterial origin. Greenhouse tests indicate that it does not impair the planting behavior and because of the relatively nontoxic nature of the chemical, the small quantity involved would not constitute a health hazard. Of course any discoloration in a tuber is objectionable. Such herbicide discolorations are quite unusual and in some cases at least may be attributed to poor coverage along with low soil moisture. Partially killed plants with deficient soil moisture might linger on for some time before dying and absorb spray or other material applied to the leaves. It is doubtful if these herbicide transfers are likely to be frequent enough to interfere with use of vine killers. However, they are a reason why highly poisonous herbicides such as sodium arsenite killers are not to be recom-

mended for vine killing, unless the tubers are definitely to be used for seed purposes only.

5. VINE KILLING IS EFFECTIVE IN EARLY HARVEST. Florida tests for leafroll and other virus diseases indicate that killing the vines with chemicals can be almost as effective as hand pulling for early harvest if the vines have been thoroughly treated with effective herbicides. Applications of herbicides with sprayers not adadjusted to give good coverage cannot be considered equal to hand pulling. *When early harvesting is done with use of vine killers it is particularly important that the operation be done early.* Comparable disease readings of tubers from hand pulled and chemically killed plants were obtained in the Florida tests only when the vines had been treated early. The longer chemical vine killing was delayed, the less effective the method was as compared to hand pulling. Some vines may have virus infection in them and yet tubers may be obtained free from virus if these vines are completely removed by pulling. With chemical killing there is still time for the virus in the stems to travel to the tubers. Sprays such as sulfuric acid which produce almost instantaneous killing of the vines ought to be more effective than those requiring several days for the vines to die.

6. TIMING VINE KILLING FOR EARLY HARVEST. The producer of seed potatoes is confronted with a difficult decision at time of early harvest. The longer it can be delayed the greater will be the yield. However, if the grower hesitates too long he runs the risk of having a higher percentage of diseased tubers. With very rapid killers such as sulfuric acid the vine killing should be done at the same time as hand pulling would have been done. Preliminary data indicate that some tuber growth may take place after vines are sprayed with some of the slower acting vine killers such as Sinox and Dowspray "66." If these data are further substantiated, it would mean that the date of chemical vine killing with such sprays might well be advanced a few days ahead of the time for hand pulling, allowing the same yield, but giving a safety period to take care of the interval required for killing.

Florida Test 1944-45. Wesley F. Porter, Donald Merriam, M. R. Harris, Joel Daigle, Stan Lightbody, Geddes W. Simpson, E. L. Newdick. During the winter of 1944-45 the Maine Agricultural Experiment Station, in cooperation with the Maine Department of Agriculture, again conducted a Florida Test in the vicinity of Aladdin City, Florida.

Both the number of samples entered in the test in 1944 and the acreage the samples represented were the largest since the test was started in 1937. The increase of 419 samples over the number of samples entered in 1943 was due to the larger acreage passing certification in 1944, the increase of 100 acres entered in the Foundation Program, and the increase in the number of acres of the Chippewa variety that passed field inspection in 1944. According to the rules and regulations made by the Seed Certification Service, all fields of the Chippewa variety passing field inspection must be tested in Florida.

Three hundred ten different growers entered a total of 1,085 samples in the 1944-45 test. One hundred eight of the samples entered were taken from the seed plots entered in the 1944 Foundation Program. Sixty-one samples were taken from experimental plots. Nine hundred sixteen samples were taken from tuber unit fields or from fields that were certified in 1944.

Weather conditions were unusually favorable for normal and rapid plant growth. As a result it was possible to complete readings on all varieties entered in the test earlier than in any previous year. Final readings were made on the Chippewa and Sebago varieties by January 11. The readings were completed for other varieties by January 20. In general the leafroll virus was found in higher percentages than any of the other common virus diseases. Ring rot was found in one sample.

A summary of the number of lots of seed by variety and acreage entered in the 1941-1942-1943-1944 Florida Tests and the number of lots and acreage of each variety recommended for table stock or for certified seed are given in Tables 37, 38, and 39.

In 1944 only 22 per cent of the total acreage entered in the test did not exceed the disease tolerance of 2 per cent total virus. Thirty per cent of the total acreage did not exceed 10 per cent leafroll. Forty-eight per cent of the total acreage was not recommended for use as certified seed or table stock seed. These results reflect the greatly increased aphid populations found on potatoes in 1944 as compared with the more favorable conditions of 1943. They also show how valuable the Florida Test can be in preventing the use of badly diseased potatoes for seed.

STEM-END BROWNING. ***Transmission of Susceptibility to Stem-End Browning.*** A. Frank Ross. In 1943, plugs from tubers of a Green Mountain strain susceptible to stem-end browning were

grafted into seed pieces of a resistant strain. On plot #1 (Table 27) about 50 per cent of the grafted units showed an increase in susceptibility over their corresponding controls. The progeny of these grafted units and their controls were replanted in 1944. The progeny of the grafted units were still much more susceptible to stem-end browning than the parent material. Furthermore, they produced almost as much stem-end browning as the susceptible strain from which the plugs were taken. Plot 2 was essentially the same except that all units were replanted. In both 1943 and 1944 the grafted units were intermediate in susceptibility, indicating that transmission of susceptibility occurred in some of the units. There was no indication of transmission by leaf inoculation.

In 1944, tubers of a resistant strain were planted in the field. Later in the summer, a susceptible strain was used for inarch grafting, i.e., a stalk from a susceptible strain was grafted to a stalk of the resistant strain. Those units where actual union occurred, together with their corresponding controls, were dug and the tubers stored at 50° F. The ungrafted controls averaged 9.4 per cent stem-end browning and the grafted units 34.1 per cent. Seventy-three per cent of the grafted units showed an increase over their corresponding controls. All stem-end browning readings were made after storage for 100 days or longer at 50° F.

The data in this section are interpreted as evidence that a virus is concerned in susceptibility to stem-end browning. Apparently one difference between the resistant and susceptible strains is that the latter contain a virus not present in the former. Evidence at hand indicates that under natural conditions, this unknown virus spreads very slowly or not at all in Maine. In either case, the recommendation that susceptible strains be eliminated is still valid.

Source of Seed and Stem-End Browning. A. Frank Ross. Several lots of foundation Green Mountains were tested for susceptibility to stem-end browning. The results are presented in Table 23. The lots are listed according to strains, as far as is known. The term strain is used in its popular sense, not according to its scientific definition. It may be noted that several lots that have been grown in Maine for many years were fully as low in respect to stem-end browning as the Minnesota lot, which has been used the past three or four years as a typically low stem-end browning lot. In fact, it seems probable that the Keswick strain may be the only one that is highly susceptible. It would be very desirable

for anyone who has the Keswick strain, or who has an unknown strain that gives trouble from stem-end browning, to change to the Highmoor, Vermont, or Phillips strain. While these strains are not immune and may under some conditions give considerable stem-end browning, they will in general produce less than one-third as much stem-end browning as the Keswick when grown under the same conditions.

Tuber Lines. A. Frank Ross. Tuber lines of any given strain all behaved the same with respect to stem-end browning. Those selected for resistance to stem-end browning were no lower than the parent lot. There appears to be two, and only two, degrees of susceptibility to stem-end browning, highly susceptible, typified by the Keswick strain, and fairly resistant, typified by the Highmoor strain or the Minnesota lot.

Date of Planting and Stem-End Browning. A. Frank Ross. Stem-end browning readings were taken on the tubers from plots planted at 3 different dates and from which samples were dug at 3 different dates (Table 24). Stem-end browning was much lower in the early-planted rows, and increased with each later date of planting. This was true for both the Keswick strain and the Minnesota lot, regardless of the date of digging. It should be noted that the early-planted Keswick was lower in stem-end browning than the late-planted Minnesota lots. This emphasizes the fact that the use of resistant strains will not guarantee low stem-end browning readings under all conditions or that the Keswick strain will always be high. The data in Table 22 from 13 different plots show the same trend, especially in the case of the resistant strains. These data and those in the section on Source of Seed suggest a program that should effectively minimize stem-end browning in Green Mountains: the use of resistant strains and early planting. It has been pointed out elsewhere that early planting will also help to prevent net necrosis. Hence such a program would help to minimize both stem-end browning and net necrosis.

Date of Digging and Stem-End Browning. A. Frank Ross. Progressively later diggings up to late September result in progressively less stem-end browning. (See Tables 24 and 25.) However, late digging, for example October 7, resulted in increased amounts of stem-end browning. The effect of date of digging on stem-end browning varies from year to year. Hence it is apparently related to some unknown seasonal factor.

Effect of Calomel and Other Fungicides on Stem-End Browning. A. Frank Ross. In 1943, calomel greatly reduced the amount of stem-end browning. Repetition of the experiment in 1944 gave less effective control. In Table 25 are presented the results of an experiment where calomel was mixed with the fertilizer at the rate of 5 pounds per acre and samples were dug at 3 different dates. Except for those dug September 27, the calomel reduced the amount of stem-end browning by one half to one third. There was very little difference between the late-dug samples. Larger amounts of calomel were more effective in the case of the Minnesota (low stem-end browning) lot than was the five-pound application but not with the Keswick strain. (See Table 26.) The yield was reduced more also where the Minnesota seed was used. Other mercury compounds were less effective. Other fungicides, such as Semesàn, Spergon, Thiosan, Arasan, Cuprocide, and C-119, were not effective when applied at the rate of 5 to 50 pounds per acre. It was concluded that the effect of calomel was not due to its fungicidal properties but rather to some effect on the physiology of the plant.

Sodium Chloride and Sodium Sulfate and Stem-End Browning. A. Frank Ross, Bailey E. Brown (U.S.D.A.). Additional evidence that high chloride containing fertilizers are not desirable in potato production was obtained from a plot in which sodium chloride was added to the fertilizer. Two hundred pounds per acre increased the amount of stem-end browning appreciably, and reduced the total solids content of the potatoes slightly. Four hundred pounds per acre decreased the yield appreciably and produced about the same amount of stem-end browning as did the 200-pound application. There was no further reduction in total solids. The plants on the 400-pound plot absorbed only slightly more chloride than did those on the 200-pound plot. The addition of 400 pounds per acre of sodium sulfate did not affect yield, stem-end browning, or total solids to any great extent.

Fertilizer and Stem-End Browning. Joseph A. Chucka, Arthur Hawkins. PERMANENT PLOTS. Tuber samples taken from the permanent plots in 1944 and examined for development of stem-end browning showed about the same effects from fertilizer treatments as were observed in previous years. Stem-end browning tended to increase with the amount of fertilizer applied, with

percentage of potash in the fertilizer, and with the amount of chlorine in the fertilizer. (See Table 16.)

FERTILIZER TESTS ON NEW LAND. Many of the fertilizer treatments on the permanent plots have been repeated on the same land for as many as 18 years. Thus the data on stem-end browning obtained from these plots should be the result of the residual effect of fertilizer treatments. To measure the more immediate effect of certain fertilizer treatments on the development of stem-end browning an experiment was laid out on a piece of land on Aroostook Farm which had not been previously fertilized. The fertilizer treatments used included several rates of application (none, 2500, and 3500 pounds per acre). They included fertilizer without potash and with potash from three different sources and they included treatments with and without added chlorine, boron, and copper. The effect of these treatments on potato yields and on the development of stem-end browning is shown in Table 17. None of the treatments used produced potatoes that were free from stem-end browning. In fact the percentages of stem-end browning developed in the tubers grown on this new land were nearly as high as those obtained from the permanent plots.

BORON IN POTATO FERTILIZERS. Several levels of boron in the form of borax, spent boron catalyst, and boron silicate glass were added to potato fertilizers to study their effect on the devolopment of stem-end browning. These materials tended to reduce somewhat the amount, and particularly the severity, of stem-end browning. They offer no possibility as a corrective measure, however, because they are extremely toxic to the potato plants. Their use resulted in yield reductions all the way from 14 to 73 barrels per acre. (See Tables 18 and 19.)

LATE BLIGHT. Reiner Bonde. The losses caused by late blight were relatively small in most parts of the State in 1944. The disease was found in a number of different places on July 8 and enough sources of infection were present to start an epidemic. However, the progress of the disease was checked by the dry weather that prevailed throughout most of the season.

Effect of Time of Digging on Late-Blight Tuber Rot in Storage. Reiner Bonde, E. S. Schultz.[7] The losses from late-blight

[7] Much of the research on potato diseases is cooperative with the Bureau of Plant Industry, Soil, and Agricultural Engineering. Doctor E. S. Schultz is the Bureau representative on this work in Maine.

storage rot sometimes are large in Maine. Much of this rot occurs because the crop is harvested while the foliage is still green and the tubers become infected with late blight from the foliage. A few infected potato leaves or stems in a field are sufficient to inoculate a high percentage of the tubers as they are being harvested.

The results secured for the years 1942 to 1944 show the effect on the amount of late-blight tuber decay that may occur from harvesting while the potato tops are still green. These results were as follows:

Treatment of Tubers	Percentage Tuber Decay in Storage[8]		
	1942	1943	1944
Harvested and put into storage while part of the foliage was still green and infected with late blight	20	48	53
Harvested and put into storage after foliage had been killed by frost	None	4	6

Storage Temperatures and Late-Blight Rot. Reiner Bonde, E. S. Schultz. Experiments were conducted in 1944 for the purpose of securing further information on the amount of late-blight rot that may occur in potatoes stored at different temperatures. There was little natural infection of late blight in the field, the crop of which was used for these experiments. Therefore, the disease was introduced into the plots by artificial inoculations. While the foliage was still partially alive the potatoes were harvested and placed in storage bins with temperature ranges from 36° F. to 70° F.

Two separate experiments were conducted. One lot was harvested and put into storage on September 10 and the other on September 19. The results of these experiments are given in Table 40.

Very little late-blight decay developed in the tubers stored at 36° F. The amount of late-blight rot increased as the temperature was increased above 36° F. except that there was no significant difference in the development of the rot as the temperature was

[8] Average from eight 50-pound samples for each treatment after storage for an eight-week period.

increased from 50° F. to 70° F. It was noted that a dry rot occurred at the lower temperatures and at the higher temperature a soft wet rot developed.

Control of Late-Blight Tuber Rot by Killing Tops with Weed Killers. Reiner Bonde, E. S. Schultz. Experiments were conducted in 1943 and 1944 to determine whether or not late-blight tuber rot can be controlled by killing the potato tops with a chemical weed-killer before the crop is dug. The results of these experiments are summarized as follows:

Treatment	Percentage of tuber decay	
	1943	1944
Tubers dug and put into storage while tops were still green	40	54
Tops killed, tubers dug and stored 2 days later[9]	11	14
Tops killed as above but tubers dug 10 days later[9]	3	3
Tubers dug and put into storage after tops were killed by frost	6	0

It is apparent that late blight tuber rot can be greatly reduced by killing the infected tops before the crop is dug. It is not safe to harvest the potato crop before the plants are dead if late blight is present. The foliage may be killed by applying a chemical weed-killer when maturity is delayed or when killing frosts occur late in the season.

High-Temperature Treatment for the Control of Late-Blight Rot. Reiner Bonde, E. S. Schultz. An experiment was conducted in 1944 to determine whether a "high temperature" treatment could be used for the control of late-blight decay.

Potatoes were harvested from a field in which the foliage was slightly infected with late blight. These potatoes were divided into uniform 50-pound lots which were subjected to different high-temperature treatments. Each treatment was for a 24-hour period after which the potatoes were put into commercial storage. One lot was treated immediately or soon after being harvested, and

[9] Tops killed with Sinox used at rate of two gallons of Sinox and 10 pounds of ammonium sulfate in 100 gallons of water applied at rate of 140 gallons per acre.

other lots were treated 24 and 48 hours, respectively, after they had been harvested. Two similar experiments were conducted. (See Table 41.)

The heat treatments did not eliminate the development of late-blight rot. The amount of rot that developed, however, was reduced considerably when the tubers were treated immediately or soon after digging.

The temperature of the treatments fluctuated considerably and for Experiment 1 it dropped to 85° F. during the night. It is possible that better results would have been obtained provided the temperature had been somewhat higher and more constant throughout the period of the treatment.

Potato Refuse Piles. Reiner Bonde, E. S. Schultz. A large number of potato refuse piles were destroyed in 1944 as a result of the campaign for their elimination. However, there were many other refuse piles which were not found and these were a source of late-blight infection for the community. During a search for a period of a few hours three infected refuse piles were found on June 28. Another infected refuse pile was reported as found on June 26.

In some cases cull potatoes are discarded in grain fields or some out-of-way place where they escape detection. Potato growers should make every effort to destroy the growing potatoes in refuse piles and in this way reduce the cost of spraying and the losses from late blight.

Effect of Different Spray Schedules on Yield and Control of Diseases. Reiner Bonde, Clifford Soucy. An experiment was conducted in 1944 to learn the effect of different spray schedules on the control of disease and on the yield rate. Several types of spray schedules were tried similar to those commonly conducted by the farmers of northeastern Maine. One series of plots was sprayed seven times during the season at 7- to 10-day intervals. The first two applications were omitted on a second series of plots and the last two applications were omitted on a third series. Spray applications were omitted twice at what appeared to be critical periods on a fourth series of plots. Late blight was controlled in the plots which received seven spray treatments. A trace of late blight developed in the plots that received the delayed spray schedule in which the first two spray applications were omitted. The season

was very dry, the early late-blight infection made little progress, and the yield was not affected.

Both early blight and late blight appeared in the plots where the two last applications were omitted and the loss of foliage which resulted caused what appeared to be a reduction in the yield rate although this reduction in yield is not significant for these data. Likewise, the omission of two spray applications at the critical period during the spraying season resulted in defoliation of the plants and an apparent reduction in yield. The yields are in accordance with the Protective Coefficient which is an index of the relative amount of disease that resulted from the different spray treatments. (See Table 42, Footnote 2.)

Delayed Spray Program for the Sebago Variety. Reiner Bonde, Clifford Soucy. The Sebago variety has been relatively resistant to late-blight infection in experiments conducted in Aroostook County. It was shown, however, that spraying is highly beneficial in spite of the fact that this variety is resistant to late blight. An experiment was conducted in 1944 to determine whether it would be more profitable to apply fewer applications of fungicides when spraying Sebagos than the normal schedule recommended for the Green Mountain and other susceptible varieties. One part of a field of Sebago potatoes was given eight applications of Bordeaux and another part was given eight applications of Basic Copper Sulfate applied at 8- and 10-day intervals throughout the summer. Other adjacent parts of the same field received only six applications of fungicides, the first applications (July 13 and 20) being omitted.

The yields for the area sprayed with Bordeaux were higher than for the unsprayed section. (See Table 43.) Furthermore, the yield rate for the delayed spray schedule was somewhat more than for the normal schedule. It is of interest to note that spraying with Basic Copper appeared to have caused a reduction in the yield rate for these experiments. Late blight was practically absent from this field and apparently was not a factor which influenced the yields secured in these experiments.

Comparison of Different Copper Fungicides. Reiner Bonde, Clifford Soucy. Three of the newer copper fungicides were compared with Bordeaux mixture on the Green Mountain variety. Bordeaux treated plots gave the lowest yield rate in 1944. (See Table 44.) This was true, not only for this experiment but for

others as well. This was in spite of the fact that Bordeaux gave the best control of early and late blight and of flea beetles.

Non-Copper Containing Fungicides. Reiner Bonde, Clifford Soucy. There is a considerable interest on the part of the different chemical companies in the development of non-copper fungicides which can be used effectively for spraying potatoes. A number of these new materials have considerable fungicidal value and show promise as potato spray fungicides.

An experiment was conducted in 1944 comparing certain non-copper fungicides with Bordeaux and with Basic Copper Sulfate which is a neutral copper fungicide. The results of this experiment are summarized in Table 45. The plots sprayed with the non-copper fungicides yielded somewhat more than did the plots sprayed with Bordeaux and with Basic Copper Sulfate, although the differences were not great enough to be considered as significant. No late-blight tuber rot was observed in the plots sprayed with Bordeaux. In contrast the decay was present in the plots sprayed with the other fungicides.

Reduction of Copper and Lime in Bordeaux Mixture. Reiner Bonde, Clifford Soucy. The data secured in 1944 confirm those secured in previous years and showed that the amount of copper and lime in the formula for making Bordeaux may be greatly reduced with no significant reduction in yield rate. (See Table 46.) The yield rate was not significantly reduced by changing the formula from 10-10-100 to 4-2-100.[10] The control of late blight was not a serious problem in 1944, but information was secured on the ability of the different Bordeaux mixtures to control flea beetles. The highest concentration of Bordeaux mixture, namely, 10-10-100, gave the best flea beetle control when applied to the Green Mountain variety. Reducing the lime content in the formula from 10 pounds to 5 pounds per 100 gallons of spray mixture appeared to allow a slight increase in the amount of flea beetle injury when applied to the Katahdin variety. In general the degree of flea beetle injury increased as the copper sulfate and lime were decreased in the formula. This greater amount of flea

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[10] The first number of the formula gives the pounds of copper sulfate per 100 gallons of spray material, the second number gives the pounds of lime used per 100 gallons of spray material, and the third number gives the gallons of water.

beetle injury, however, was not sufficient to depress the yield rate in these experiments as much as the yield was increased otherwise.

Basic Copper Sulfate with Rotenone on Katahdin. Reiner Bonde, Geddes W. Simpson, Clifford Soucy. It has been shown in previous studies that the yield rate of the Green Mountain and Sebago varieties was increased when sprays were used containing rotenone in combination with the copper fungicides. It was desired to learn whether the yield rate likewise is increased in the Katahdin variety by applications of rotenone in the spray mixture. The results of this experiment on this problem have been summarized in Table 47. The addition of rotenone to the copper sprays resulted in an increase in yield of 15 barrels (40 bushels) per acre in 1944. This increase is significant at the 1 and the 5 per cent levels, and was sufficient to pay for the additional cost involved for the purchase of the rotenone that was used. It is thus seen that the addition of rotenone to the spray mixture is beneficial and increases the yield rate when used for spraying the Katahdin variety as well as for spraying the Green Mountain and Sebago varieties.

The question naturally arises as to the reason that the addition of rotenone increased the yield rate in these experiments. Both early and late blight were practically absent and were not factors which materially influenced yield. Although there was relatively little disease present, the plots that were sprayed with rotenone were darker green and continued to grow about 10 days longer than did the plots that did not receive rotenone. This longer growth of the plants, no doubt, was responsible for the larger yields that were secured.

There was relatively little flea beetle injury in these plots. It may be noted from the data in Table 48 that the amount of flea beetle damage was approximately the same for plots that received rotenone as for those that did not. Flea beetle control therefore was not the factor affecting the yield rate of the plots that were sprayed with rotenone.

Aphids were extremely abundant in 1944 and caused a considerable amount of damage to the potato foliage, especially to the Katahdin variety. The applications of rotenone, no doubt, reduced the aphid population in the plots included in this experiment and it is probable that this reduction was the chief factor which contributed toward larger yields.

Yield Rate, Early Blight, and Flea Beetle Injury in Green

Mountains Sprayed with Copper Fungicides and Rotenone. Reiner Bonde, Geddes W. Simpson, Clifford Soucy. Further studies were conducted in 1944 regarding the compatibility of rotenone with copper spray fungicides when applied to the Green Mountain variety. Data were secured regarding the yield rate for the different treatments as well as for the relative control of early blight and flea beetles. (See Table 48.)

The plots which received the Bordeaux mixture spray applications remained green and growing longer than did the plots with other treatments. The Bordeaux plots, also, were infected less with early blight and were injured less by flea beetles than were the plots sprayed with Basic Copper Sulfate and the other materials. However, it may be noted that the yield rate was somewhat less for the Bordeaux treatment than for Basic Copper Sulfate in spite of the fact that the condition of the foliage was superior in the Bordeaux plots. With better weather conditions for the growth of potatoes than prevailed in 1944, the prolonged life of the plants afforded by spraying with Bordeaux would no doubt have resulted in increased yields.

Rotenone increased the control of early blight when in combination with either Bordeaux or Basic Copper Sulfate but had only slight fungicidal value, if any, when applied in the absence of a fungicide. The addition of zinc sulfate to rotenone in the spray mixture did not increase its fungicidal or insecticidal value.

Spray Kast with Basic Copper Sulfate. Reiner Bonde, Clifford Soucy. Many inquiries have been received from farmers regarding the value of Spray Kast for the control of potato diseases and insects.[11]

A spray mixture of Spray Kast and Basic Copper Sulfate was compared with Basic Copper Sulfate spray used alone regarding the ability to control the blight diseases. The plots received six applications during the season. Observations made just previous to a killing frost revealed no apparent difference in the general appearance of the plots. The comparative yields secured are given in Table 49. The yield was somewhat less on the plots that received Spray Kast in addition to the copper fungicide. This reduction in yield, however, is not significant for these data.

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[11] Supplied by Woburn Chemical Corp., Harrison, N. J., and said to be giving remarkable results when used on potatoes. Said to contain Cryolite.

Soya Bean Oil with Basic Copper Sulfate. Reiner Bonde, Clifford Soucy. Information secured in 1943 showed that the addition of soya bean and herring oil to the spray mixture increased the amount of metallic copper that was retained on the leaves. Further information was obtained in 1944 regarding the value of adding oil to the copper fungicide using the Green Mountain variety and Basic Copper Sulfate. Soya bean oil was used instead of fish oil because it is less toxic to the potato foliage. The plots received six applications of spray.

The formula for making the spray material is as follows:

Basic copper sulfate............	5 pounds
Soya bean oil..................	1 quart
Santomerse (detergent)........	1 pint
Water.........................	100 gallons

The addition of soya bean oil caused no apparent difference in the general appearance of the sprayed foliage. This is in contrast with data secured in 1943 when the addition of an oil resulted in greener foliage and a delay in date of maturity of the plants. The plots sprayed with the oil fungicide yielded only a barrel more per acre than did the control plots which received no oil which also is contrary to the results secured in 1943. (See Table 50.)

Puratized N5-X.[12] Reiner Bonde, Clifford Soucy. An experiment was conducted in 1944 to determine whether "Puratized N5-X" has fungicidal properties and can be used for spraying potatoes for the control of early and late blight. The plots were sprayed six times during the season using a horse-drawn wheel-traction outfit which applied approximately 100 gallons of spray per acre. Late blight was absent from these plots and, therefore, no information was secured regarding the ability of the material to control this disease. However, the general appearance of the plots sprayed with Puratized N5-X was inferior to that of the control plots which were sprayed with Basic Copper Sulfate.

The yield rate for the plots sprayed with Puratized N5-X at the rate of 1-1000 was slightly less than for the controls and was

[12] Puratized N5-X supplied by Puratized, Inc., 250 West 43rd St., N. Y., N. Y., said to contain 11.6 per cent toxicant. Said to control apple scab at a concentration of 1-1000 by volume which is a dilution of 1-8620 of the toxicant.

significantly less when the concentration of the Puratized spray mixture was increased to 2-1000. (See Table 51.) It would appear that this material is toxic to the plant when used at this concentration. It should be recalled that Puratized N5-X was very toxic to cut potato seed pieces and greatly reduced the stand, even when used at low concentrations, namely, 1 part in 1000 by volume (1-8620 of the toxicant).

PURPLE TOP. Reiner Bonde. ***Purple Top Transfer by Inarch Grafts.*** In previously conducted experiments the symptoms of purple top were not transmitted by means of tuber grafts. The disease also was not produced when plants grown from the seed tubers of purple top hills were grafted by the inarch method into healthy plants. During the season of 1943 attempts were made to transmit the disease by the "inarch" graft method using plants that had current season symptoms of purple top.

No purple top symptoms were apparent either during the current season or in the plants that were produced when the tubers from grafted plants were planted the following spring. (See Table 52.) It, however, may be noted that the inarch grafts did result in the development of weak sprouts in all of the three lots. The data indicate that some virus or other substance was transmitted from the diseased plants to the healthy plants as a result of the inarch grafts and resulted in the production of weak sprouts.

Recovery of Seed Stocks Having Purple Top. Studies were continued in 1944 to obtain additional information regarding the recovery of seed stocks having purple top. In 1943 a seed stock one year removed from purple top yielded about 85 per cent as much as did the healthy controls. A seed stock which was two years removed from purple top yielded 54 barrels more per acre than did the healthy control seed stock. The seed stocks were all stored under the same conditions and received the same cultural treatments during the growing season. Eighteen 4-hill replicated plots were included for each seed lot. The tubers were harvested by hand and the weights of tubers obtained were recorded in the field.

The yield rate from the seed stocks which had recovered from purple top was in no case significantly less than it was for the healthy control seed lots. (See Table 53.) Seed lots nos. 1, 2, 6, and 7 yielded somewhat more than did the healthy controls. Seed lots nos. 3 and 4, in contrast, yielded somewhat less than the con-

trols. However, both of these lots had approximately 13 per cent leafroll, a factor which probably depressed the yield rate somewhat.

Thus the data secured in 1944 confirm those secured in 1943 that the purple top disease does not permanently depress the yield rate in the Sebago and the Katahdin varieties. In fact the data of 1943 and 1944 both indicate that purple top may increase the yield rate after the seed stock has recovered from the shock of the initial infection.

The reason that the seed stock which had recovered from the disease yielded more than did that from seed stocks that never had the disease is not understood. It was observed in the experiments recorded above that the tubers that had recovered from purple top produced more stems than did the tubers from healthy plants. It also was noted that all of the eyes of the disease recovered seed stocks germinated and produced vigorous sprouts. In contrast, there was a tendency for only the apical bud of the tubers from the healthy seed stocks to produce vigorous sprouts. Such apical-dominance sprouting no doubt would affect the yield rate.

Tests for Possible Acquired Immunity to Purple Top. Studies have shown that the tubers from hills infected with purple top may recover from the severe effects of disease (Bonde, Maine Bul. 426, p. 243). Many tubers from infected hills when planted produce only small tubers attached to the mother tuber and so produce no plant foliage. The tubers from purple top plants also may produce weak sprouts and plants. However, the seed tubers from these weak plants will produce plants that are normal in appearance and in their yielding ability when planted the following season. The question naturally arises as to whether or not the seed stock that has recovered from purple top is immune to the disease.

Katahdin and Sebago seed stocks selected in 1941 and 1942 from purple top hills were used for a study of this question. All of these stocks apparently had recovered from the disease and had produced normal plants and a good crop in 1943. They were planted by hand along the border of a field where it was expected the disease would be prevalent. Some of the seed tubers were planted whole and some were cut as is commonly done in Maine.

Very little purple top was present in the plants included in the test. (See Table 54.) This was in spite of the fact that the six-spotted leaf hopper was very abundant in Aroostook County during

1944. The aster yellows disease also was prevalent in the near vicinity of the field in which this experiment was conducted. The six-spotted leaf hopper was so abundant that every lettuce plant in two nearby plots contracted the aster yellows disease. The aster yellows disease also was prevalent in carrots and other cultivated and wild plants grown in the vicinity of the potatoes which were being tested regarding their immunity to purple top.

Although the disease was not prevalent in these plots, the data do indicate that the seed stock which had recovered from purple top was not immunized toward further infection. A trace of purple top developed in Lots 6 and 7 which were selected in 1941 and in Lots 8 and 9 which were selected in 1942.

Aphid Population on Healthy and Purple Top Plants. It has been observed that plants having the purple-top disease apparently had a denser aphid population than did the nearby healthy plants in the same field. It seemed of value to determine whether this was true by making actual counts under field conditions. Healthy and purple-top plants of the Sebago variety were compared. The data were secured by counting all of the aphids that were present on one terminal leaflet selected from the top, middle, and bottom parts of healthy and diseased plants. Aphid counts were made on 22 healthy and 22 diseased plants. (See Table 55.) The aphid population was much denser on the plants infected with purple top than it was on the healthy plants. There was an average of 33 aphids per leaflet on the top part of the healthy plant compared with an average of 73 aphids per leaflet on the diseased plant, the ratio being 2.2:1. There were 3.1 times as many aphids on the middle leaflets of the purple-top plants as there were on the leaflets from the middle part of the healthy plants. The bottom leaflets of the healthy plants had an average of 39 aphids compared with an average of 89 aphids on the bottom leaves of the diseased plants. Taking the plants as a whole, there were 2.5 times as many aphids on the plants infected with purple top as there were on the healthy plants.

These data confirm the contention that plants infected with purple top may have a higher infestation of aphids than do the healthy plants in the same field. Purple-top plants apparently have an accumulation of food material which is not translocated to the tubers. This food material which accumulates in the leaves seems to be favorable for the development of the aphids.

SEED DISINFECTION OF POTATOES. Bernie E. Plummer, Jr., Reiner Bonde. Further study was made of the use of acid mercuric chloride and non-acidulated mercuric chloride solutions in the disinfection of seed potatoes. One half of one per cent acetic acid with mercuric chloride was used in 5- and 90-minute dips. Mercuric chloride barely acidulated with hydrochloric acid was used in a 5-minute dip. A standard dip using non-acidulated mercuric chloride was studied.

All of the acidulated samples retained nearly their original strength of mercuric chloride even up to 25 consecutive dips. The standard non-acidulated dip lost nearly half its mercuric chloride content during 25 dips. The addition of a small amount of acid therefore prevents the loss of mercuric chloride from solution when used in the disinfection of potatoes. (See Tables 56 and 57.)

FOUNDATION SEED PROGRAM. Wesley F. Porter, Roger M. Cobb, Donald Merriam, Geddes W. Simpson. Several recommendations are considered essential to the successful growing of foundation seed. Among the more important are (1) a source of seed known to be free of bacterial ring rot, (2) a source of seed with a low virus content, (3) early planting by tuber units, (4) adequate isolation from other fields of potatoes, (5) careful thorough roguing, (6) clean cultivation, (7) early harvesting, especially in years when plant lice are abundant, (8) storage on the farm where contamination of seed stocks will not occur, and (9) advance testing of seed to insure quality for the next year's planting.

Observations in Florida have indicated that many seed stocks of the newer varieties are badly infected with various latent mosaics. It was decided several years ago that the Foundation Program could serve a more useful purpose if seed stocks free from latent mosaic could be produced and distributed since experimental data had shown that these mosaics are capable of reducing yields materially.

Seed stocks from what were considered the best lots were tested in the greenhouse using Datura plants during the winter of 1940-41 and certain tubers found to be free from latent mosaics were multiplied at McNally. These stocks have been retested from time to time and have been released as rapidly as they could be built up. Recently, all available stocks have been fed into the Foundation Program where they are being multiplied by foundation growers who in turn sell to certified seed growers. Eventually it is hoped

that this system of selecting the best possible stocks may be expanded so that in time there will be a flow of good seed from the greenhouse test right through to the table-stock grower.

In 1944, 37 growers entered approximately 342 acres in the Foundation Program. This acreage is the largest ever entered in the program. The acreages and the varieties entered were: 135 acres of Green Mountains; 38.5 acres of Sebagos; 32.9 acres of Katahdins; 85.7 acres of Irish Cobblers; 41.7 acres of Chippewas; .75 acre of Sequoias; 7.2 acres of Mohawks; 1.5 acres of Houmas; 0.1 acre of Early Rose. The total acreage was planted in 112 different plots. The plots were located in the counties of Aroostook, Penobscot, and Piscataquis.

In general the most satisfactory results cannot be obtained when seed plots are planted later than May 20. In 1944 planting dates ranged from May 5 to May 22. Very few plots were planted after May 20.

Most plots were rogued once a week for a period of six weeks beginning the last week in June. Nearly all plants showing symptoms of leafroll and mosaic were removed from the plots by July 20.

Experience has shown that early harvesting is one of the most important factors in the control of leafroll. It is evident that information gained from records of aphid flights can be used successfully in determining the time when early harvesting operations must be started. From studies conducted on aphid flights at Aroostook Farm in 1944, it was apparent that the most satisfactory results would be obtained if early harvesting was completed by August 12. In 1944 early harvest dates ranged from August 5 to August 20. A number of growers early harvested later than August 12 because of unsatisfactory yields. In such cases most growers sacrificed quality of seed for quantity.

Owing to a labor shortage this year several growers early harvested by killing the tops with chemicals. Hand pulling the tops was recommended as the most effective method for virus control. If labor was unavailable to pull tops on the whole plot, it was recommended to each grower to early harvest enough seed for his 1945 seed plot by hand pulling and kill the tops on the remainder of the plot by using chemicals. Good results were obtained with chemicals on the Irish Cobbler and Chippewa varieties where the killing was done early and a complete killing of the vines was

obtained. The results obtained by the use of chemicals in comparison to hand pulling are listed below.

	Tops hand pulled	Tops killed with chemical	Late harvest
Number of plots	53	31	13
Number of plots with Florida samples under 2 per cent leafroll	50	9	6
Percentage of samples in Florida test below 2 per cent	94.3	29.0	46.1

Samples were taken from the foundation plots and grown in Florida during the winter of 1944-1945 to determine the amount of virus disease present in the different lots.

A summary of the acreage of each variety qualifying as foundation seed is given in Tables 58 and 59.

POTATO SCAB. Joseph A. Chucka, Ferdinand H. Steinmetz. Two blocks of 100 plots each were laid out at Aroostook Farm on a field that had a pH of about 5.5 to study the effect of pH and several types of added organic matter on the incidence of potato scab. To secure a range in pH, 40 plots in each block were treated with sulfur, 40 plots were treated with limestone, and 20 plots were left untreated. Across the sulfur and lime treatments several types of organic matter (oat stubble, buckwheat, crimson clover, oat straw, manure, and peat) were plowed under. The buckwheat and crimson clover were grown and plowed under on the plots while the straw, manure, and peat were applied to some of the oat stubble plots and plowed under.

Each year one block of 100 plots is planted to oats, buckwheat, and crimson clover while the other block of 100 plots is planted to potatoes. The effect of these treatments on pH, scab, and potato yield in 1944 is shown in Table 60. The plots are divided into four groups based on the amount of potato scab developed on the tubers. Clean tubers were produced on 38 plots, tubers with only a very small amount of scab were produced on 20 plots, tubers with considerable scab were produced on 19 plots, and very scabby tubers were produced on 23 plots. The plots which produced clean potatoes had a pH range of 4.08 to 5.41. The plots which produced

scabby potatoes ranged in pH from 4.52 to 6.28. The amount of scab on the tubers was definitely correlated with pH but there was considerable overlapping in pH between the groups of plots. The average content of replaceable calcium was also definitely correlated with the amount of scab on the tubers. There was only a slight tendency for the replaceable potassium to go up with increasing amounts of scab. In general the dividing line between clean potatoes and scabby potatoes was at a pH of 5.5 and a replaceable calcium content of 2000 pounds per acre.

The kind of organic matter added had comparatively little effect on the incidence of potato scab. At a pH of about 5.5 (the border line between clean and scabby potatoes) the addition of manure had a slight tendency to increase the amount of scab while plowing under crimson clover or buckwheat tended to decrease scab slightly.

SOIL FERTILITY

FERTILIZATION. ***Fertilizer Ratio Test.***[13] Arthur Hawkins, Joseph A. Chucka, Bailey E. Brown. Four levels of nitrogen (40, 80, 120, and 160 pounds of N per acre), three levels of phosphoric acid (60, 120, and 180 pounds of P_2O_5 per acre) and four levels of potash (100, 160, 220, and 280 pounds of K_2O per acre) were compared on each of four farms during 1944. No increases in yield were obtained with increased plant food beyond 80 pounds of nitrogen, 120 pounds of phosphoric acid, and 160 pounds of potash. The highest level of nitrogen (160 pounds N per acre) and the two highest levels of potash (220 and 280 pounds of K_2O per acre) not only failed to increase yields but actually depressed them. This rather low response to plant food in 1944 may have been due to the rather inadequate rainfall.

Fertilizer Placement. Joseph A. Chucka, Arthur Hawkins, Bailey E. Brown. In one placement experiment with potatoes at Aroostook Farm all plots received a 6-6-12 fertilizer at the rate of 2000 pounds per acre. In treatment 1, all of the fertilizer was

[13] The studies with potato fertilizers are cooperative with the Division of Soil and Fertilizer Investigations, and the Division of Fruit and Vegetable Crops and Diseases. Arthur Hawkins and B. E. Brown, respectively, are the representatives of these Divisions on these studies in Maine.

placed in the row in bands at planting time. In treatment 2, one half of the fertilizer was applied in the row while the remainder was broadcast prior to plowing. In treatment 3, one fourth of the fertilizer was applied in the row and three fourths was applied broadcast prior to plowing. In treatment 4, one fourth of the fertilizer was applied in the row and three fourths on the plow sole at the time of plowing. In treatment 5, one half of the nitrogen and one half of the potash and all of the phosphoric acid were applied in the row and the remainder of the nitrogen and potash was applied broadcast prior to plowing. Treatment number 6 was similar to number 5 except that the remainder of the nitrogen and potash was applied broadcast after plowing. An average of four replicated plots produced the following yield rates of potatoes in barrels per acre: 133, 132, 124, 127, 130, and 133 respectively for the six treatments described above. Broadcasting three fourths of the fertilizer prior to plowing (treatment number 3) resulted in a significantly lower yield than placing all of the fertilizer in the row. The other split-application treatments were nearly as good as, but no better than, the standard band placement method (treatment number 1).

In a second placement experiment with potatoes conducted on a farm near Lee, Maine, only two treatments were compared. One consisted of placing 1800 pounds of 6-9-15 fertilizer in the row at planting time and the other consisted of 600 pounds of 6-9-15 in the row and 1200 pounds of 6-9-15 applied on the plow sole. The plowing was done in the spring about 10 days prior to planting. The fertilizer was applied on the plow sole in two bands with an International distributor attached to the plow. Each plot consisted of 18 rows of potatoes about 800 feet long. The potatoes on the split-application plot grew larger vines but due to the extremely dry and hot weather the plants on both plots died prematurely and produced a very low yield. The plot receiving all of the fertilizer in the row produced 72 and the split-application plot produced 77 barrels of potatoes per acre.

Permanent Plots. Joseph A. Chucka, Arthur Hawkins, Ferdinand H. Steinmetz, Bailey E. Brown. The 1944 potato yields from the permanent plots are in general agreement with those secured in previous years and summarized in Bulletin 414. In the rate of fertilizer application series in which 0, 1500, 2000, 2500, and 3000 pounds per acre of a 4-8-8 fertilizer were compared, the

potato yields increased with amount of fertilizer applied up to the 2500 pound rate. In the fertilizer ratio series in which each of the three major elements was varied while the other two were held constant, potash again was the most effective in increasing potato yields. Responses in yield to potash were obtained up to a rate of 240 pounds of potash per acre. In the series comparing sources of nitrogen, highest yields were secured with the 4-8-8 fertilizer in which all of the nitrogen was supplied as urea. Potassium chloride and potassium sulfate used as sources of potash at the rate of 160 pounds of K_2O per acre produced approximately equal yields on the permanent plots in 1944.

On four plots in the two-year rotation series a fertilizer placement study was conducted in 1944. All four plots received a total of 2500 pounds per acre of a 4-8-10 fertilizer. On plot 1 all of the fertilizer was placed in the row in bands at planting time. On plot 2, three fourths of the nitrogen was broadcast and harrowed in prior to planting, the remainder of the nitrogen and all of the phosphoric acid and potash were applied in the row. On plot 3, three fourths of the nitrogen and three fourths of the potash were applied broadcast prior to planting and the remainder of the nutrients was applied in the row at planting. On plot 4, three fourths of the 4-8-10 was applied broadcast prior to planting and the remainder in the row at planting time. The plots receiving the split applications of fertilizer produced slightly lower yields than did the plot which received all of the fertilizer in the row at planting time.

Minor Element Studies. A. Frank Ross, Arthur Hawkins (U.S.D.A.), Joseph A. Chucka. Tables 28 and 29 record the effect of several minor elements on yield. Two commercial products, Es-Min-El and Milorganite, reported to contain several minor elements, are also included in the tables. Contrary to previous results, strontium failed to significantly increase the yield. Es-Min-El, Milorganite, and the various minor elements, in the amounts used, all failed to produce any increase in yield. On the other hand, cobalt at the rate of five pounds per acre caused a very significant decrease in yield. Both vanadium (two pounds per acre) and the minor element mixture caused decreases in yield that are probably significant. The presence of bromide salts in the amounts commonly found in commercial fertilizers was found to have no effect upon yield.

SEED STOCK PRACTICES

Methods may be found to treat seed stocks with chemicals, vary the size of seed pieces planted, etc., as means for controlling the average number and size of tubers. These procedures may be of particular interest to seed growers but may have a bearing, also, on table-stock production.

Size of Seed Piece and Potato Yields. Joseph A. Chucka, Ferdinand H. Steinmetz. This experiment was conducted at Aroostook Farm with three varieties of potatoes—Green Mountain, Katahdin, and Sebago. The lots of seed potatoes used were as nearly disease-free as could be obtained. The seed potatoes of each variety were carefully graded into the following size ranges: 1 to 1¼ inches, 1¼ to 1½ inches, 1½ to 1 11/16 inches, 1 11/16 to 1⅞ inches, and 1⅞ to 2½ inches. The first four size ranges were planted whole and a portion of those ranging in size from 1 11/16 to 1⅞ (large seconds) was split in two. From those ranging in size from 1⅞ to 2½ inches seed pieces of three sizes, 1 ounce, 1½ ounces, and 2 ounces, were cut. This resulted in four lots of whole seed and four lots of cut seed of each variety. All lots of seed were planted nine inches apart in 36-inch rows on each of six replicated single row plots 24 feet long. Although the 1944 yields were considerably smaller than those secured in 1943, they were again correlated with size of seed piece. (See Table 61.) The yields increased with size of seed piece for both whole and cut seed. Whole seed pieces of a given weight produced somewhat higher yields than cut seed pieces of similar weight.

Plant, stalk, and tuber counts indicated that the number of stalks per plant and the number of tubers per hill increased as the size of seed piece planted increased. See figure 1. Grading data indicated a somewhat higher percentage of oversize tubers on the plots where the smallest seed pieces were planted.

Physiological Seed Treatments and Size and Numbers of Tubers. George P. Steinbauer, Ferdinand H. Steinmetz. Six chemical treatments of seed and two different spacings of seed pieces were used in addition to a control. (See Table 62.) Seed of the Green Mountain variety was used with 12-inch seed spacing unless otherwise noted. The seed was planted in 25 foot rows, with six randomized replicates per treatment. At harvest time records were obtained for number of stalks per hill, number of

stalks per replicate, and the weight and number of tubers. Tubers were graded into culls (less than 1¼ inches), 1¼ to 1⅞ inches, 1⅞ to 2⅞ inches, and over 2⅞ inches. The data obtained are presented in Table 62.

All of the chemical treatments, except the use of indole acetic acid, and the two close spacings of seed piece gave highly significant increases in total numbers of tubers over the control and either significant or highly significant increases in numbers of tubers in the preferred size group (1¼ to 2⅞ inches). These same treatments resulted in fewer oversize tubers than in the control. Total weight of tubers was significantly higher for the closer spacings than for the control. Transplantone and thiourea produced more stems per seed piece than other treatments.

FIGURE 1. Effect of size of whole and cut seed pieces.

1. Whole tubers 1 to 1¼ inches in diameter
2. Whole tubers 1¼ to 1½ inches in diameter
3. Whole tubers 1½ to 1 11/16 inches in diameter
4. Whole tubers 1 11/16 to 1⅞ inches in diameter
5. Split seconds
6. One-ounce seed pieces from tubers 1⅞ to 2½ inches in diameter
7. One and one-half ounce seed pieces from tubers 1⅞ to 2½ inches in diameter
8. Two-ounce seed pieces from tubers 1⅞ to 2½ inches in diameter

In addition to the seed treatments three organic chemicals[14] naphthaleneacetic acid, 2, 4-dichlorophenoxyacetic acid and beta-naphthoxyacetic acids were applied to the foliage as aqueous sprays at about the time that tuber formation was initiated. Concentrations ranged from 50 mg. per liter to 300 mg. per liter. Response to naphthaleneacetic acid was a decided bending or epinasty of the leaves shortly after spraying. This response persisted for 48 to 96 hours. Response to the other two chemicals was a tendency for the leaflets to become ruffled and of smaller size than on the controls. Numbers of tubers per unit length of row were not significantly greater for treated than untreated plots.

These results offer promise that some practical methods may be devised for producing larger numbers of medium sized tubers than is usually the case, without using additional quantities of seed.

STORAGE

Loss of Weight from Potato Tubers during Storage. Elizabeth F. Murphy. It may be of some interest to the potato grower to know the relative weight losses which occur in six popular varieties during storage at various temperatures. Several hundred freshly dug tubers were brushed free of soil and weighed individually. The weights were marked on the tubers which were then placed in storage bins at five temperatures. At monthly intervals for seven months, six tubers of each of the six varieties from each storage bin were removed for analysis. The tubers were weighed again and the fresh and stored weights recorded. Sprouts were removed from the tubers as these would not be considered either in marketing potatoes or in nutritional value.

The temperatures used in this study were 32, 36, 50, 60 and 70° F. It was observed that when all five temperatures were considered, the Sebagos lost the largest percentage of their original weight, averaging 13.2 per cent for the whole period. Mohawk showed a mean decrease in weight of only 7.5 per cent. A progressive weight loss during seven months for all varieties averaged 2.4 per cent after one month in storage and 19.9 per cent after seven months. Thirty-six degrees favored a minimum loss and

[14] These chemicals were furnished by Dr. P. Zimmerman of the Boyce-Thompson Institute.

50° was superior to 32° F. (See Table 65.) The higher weight loss at 32° was probably due to the severe internal mahogany browning which affected most of the tubers at that temperature.

As potatoes would not be stored at 60° or 70° F. for commercial purposes, average losses were calculated for the three lower temperatures, 32°, 36°, and 50° F. When the changes in weight are judged only by these three temperatures, it was found that Cobbler and Katahdin exhibited the lowest average losses over seven months (4.3 per cent each) while Sebago showed the highest loss at 8.7 per cent. The average weight decreases by varieties, months, and temperatures are shown in Table 65.

POTATO PRODUCTS

During the past ten years, production capacity of potato starch in Maine has more than doubled. Modernization has been most helpful in increasing percentage yields at a time when Maine cull potato prices have risen and starch content of potatoes has decreased. Some European varieties grown under commercial conditions in the Houlton district contained 13.2 to 18.5 per cent starch and may deserve some consideration from the postwar viewpoint as possibilities to be grown on a contract basis for starch manufacturers.

Experimental Potatoes. Charles A. Brautlecht. Sixty-seven lots of experimental potatoes, grown at Aroostook Farm, Presque Isle, by R. Akeley of the Bureau of Plant Industry, under comparable conditions, were examined for starch. Twenty-eight lots represented 20 domestic varieties. Starch content, number of tubers to 5 kilograms, weight of 5 kilograms in water, experimental total solids and computed total solids were determined. Total solids computed from specific gravity by the Foth table (1907) and determined experimentally, showed differences of from —0.66 to +2.74 per cent. The ratio of total solids to starch for these 28 lots of domestic varieties varied from 1.36 to 1.76 with an average of 1.575. For a number of domestic varieties and foreign varieties, 1943 crop, this ratio was from 1.4 to 1.8. The limits in starch were from 9.65 per cent (Chippewas) to 15.00 per cent for an unnamed variety. (See Tables 63 and 64.)

QUALITY OF STARCH FACTORY POTATOES. Charles A. Brautlecht. Twenty-nine samples of potatoes from starch factory hoppers or cellars were examined with the following results:

Potato starch by balance	Maximum	13.7 per cent
	Minimum	2.5 per cent
	Average	10.3 per cent
Number of potatoes to 5 kilograms	Max. (size)	14.0 per cent
	Min. (size)	93.0 per cent
	Average	42.0 per cent
Sound, marketable as table stock, over two inches		very few
Sound, under two inches		some
Bulls		none to few
Digger cuts		few to many
Off shape		none to a few
Sunburn		none to 40 per cent
Net necrosis		none to a little
Chilling injury, field and storage frost		none to much
Scab		none to a little
Late blight		none to much
Stem-end browning		none to a little
Wilt (ring rot)		none to a little
Late blight storage rot		none to some
Silver scurf		none to a little
Hollow heart		none to a little (usually in Katahdins)
Floaters		none to many
Number of eyes in Sebagos and Katahdins		about 11
Number of eyes in Green Mountains		about 17
General market appearance		very poor to a few good lots
Suitability for starch manufacture		very poor to a few good lots

POTATO STARCH CHARACTERISTICS. Charles A. Brautlecht. Thirty-one samples of potato starch from the 1944 crop were examined with the following results:

	Av.	Max.	Min.
Moisture (water per cent)	17.2	25.0	11.0
Total solids (by difference) per cent	82.8	89.0	75.0
Ash per cent	0.29	0.43	0.10
Viscosity, 1 per cent solution in 0.6 per cent NaOH at 20°, centipoises (Stormer)	3.3	4.5	2.7
Granule size, average, microns	37	47	22
Acid (cc. n/10 NaOH per 25 gram sample)	5.2	13.0	0.5
Reflectance (whiteness) to MgO per cent	92.0	99.9	83.1
pH (Hellige)	6.5	7.5	6.0
Solubles per cent	0.16	0.39	0.5

Comments: Fiber, nitrogen, and fat (ether extract) are absent from the two best of four grades of Maine potato starch. Speck count increased for the 1944 crop season, relative to the 1943 crop season, due to poorer quality potatoes, poorer fuel and lack of suitable labor.

ECONOMICS OF THE POTATO INDUSTRY

WARTIME CONDITIONS AND PRODUCTION OF POTATOES. William E. Schrumpf. The information for this study was obtained in 1944 chiefly from two sources. The first was 365 replies to a mailed questionnaire received from potato growers in the different potato-producing areas of Maine. This questionnaire supplied information concerning cropping methods, soil erosion, potato varieties, labor, seed, fertilizer, and the cost of production. The second was a 10 per cent sample of more than 55,000 Federal-State shipping point certificates of potatoes inspected in 1942 and 1943. These Federal-State certificates supplied information concerning the quality of the potato crop as indicated by the percentage of U. S. No. 1 grade defects.

Cropping Methods. Analysis of the records of the 365 Maine potato farms indicates that cropping methods were affected considerably by the increased potato acreage resulting from wartime demand.

There was an increase in cropland acreage as well as in potato acreage. From 1942 to 1944 the potato growers on these farms

increased the acres of cropland more than 7 per cent, partly by purchase, partly by hiring, and partly by using land formerly in pasture or woods. However, the crop acreage increase was not uniform. In central Aroostook the cropland increase from 1942 to 1944 was slightly less than 7 per cent; in northern Aroostook it was 4 per cent; and in southern Aroostook nearly 15 per cent.

The potato acreage on the 365 farms in this study increased about 30 per cent from 1942 to 1943 but decreased between 2 and 3 per cent from 1943 to 1944. Neither the increase in potato acreage from 1942 to 1943 nor the decrease from 1943 to 1944 was uniform as between the different areas. From 1942 to 1943 the increase in northern Aroostook was 35 per cent, in southern Aroostook 35 per cent, in central Aroostook 27 per cent, and on potato farms outside Aroostook 26 per cent. Although the potato farms as a whole showed a decrease in potato acreage from 1943 to 1944, the potato acreage in the northern area increased about 9 per cent and the acreage of the southern area showed no change. The potato acreage of the farms outside of Aroostook, however, decreased 10 per cent from 1943 to 1944 and the central Aroostook acreage decreased 6 per cent. In spite of the slight average drop in the potato acreage of the farms from 1943 to 1944, the 1944 acreage in each area was substantially above the 1942 acreage. In northern Aroostook the 1944 potato acreage was 46 per cent above 1942, 35 per cent above in southern Aroostook, 19 per cent above in central Aroostook, and 13 per cent above on farms outside of Aroostook.

Farmers have maintained an increased potato acreage partly by interrupting normal cropping methods. In order to conserve time, labor, and equipment farmers have tended more than normally to follow potatoes by potatoes on the same land. Before the wartime increase in potato acreage, normally less than 50 per cent of the potatoes were planted on land that had been in potatoes the previous year. Of the 1943 potato acreage, 65 per cent had been in potatoes in 1942, and of the 1944 acreage approximately 70 per cent had been in potatoes in 1943. This trend toward replanting of potato land seems likely to continue as long as there is a shortage of labor and equipment combined with a patriotic and price incentive to produce.

Soil Erosion. As an indication of the effect of the large wartime increase in potato acreage on soil erosion in Maine, the farmers were asked whether or not they observed increased erosion on their

farms since 1942. Replies from farmers who indicated that the topography of their farms was flat were omitted. Of the approximately 300 farmers whose replies were used, 18 per cent answered "yes" and 82 per cent answered "no." Increased erosion was observed less on small farms than on large farms. On the relatively small farms (less than 40 acres of potatoes per farm) about 14 per cent of the farmers reported increased erosion, on medium size farms (40 to 79 acres of potatoes) 24 per cent, and on relatively large farms (80 or more acres of potatoes) 32 per cent.

Potato Varieties. Of the different varieties of potatoes grown on these farms in 1944, Green Mountain ranked first from the point of view of acreage, Katahdin second, and Irish Cobbler third. The Green Mountain variety in 1944 accounted for 36 per cent of the potato acreage, Katahdin 28 per cent, Irish Cobbler 13 per cent, Sebago 11 per cent, Chippewa 7 per cent, Houma 3 per cent, and other varieties 2 per cent. The Green Mountain acreage exceeded the Katahdin acreage in northern and central Aroostook but not in southern Aroostook. In northern Aroostook 68 per cent of the 1944 potato acreage was Green Mountain and 16 per cent Katahdin, in central Aroostook 27 per cent was Green Mountain and 25 per cent Katahdin, but in southern Aroostook 19 per cent was Green Mountain and 49 per cent Katahdin.

Farm Labor. Year help was reported on 48 farms, month help on 68 farms, and day help on 221 farms. Information concerning wages for cutting seed potatoes was supplied by 250 farmers and for picking up potatoes by 292 farmers.

The average cost of year help in 1943 was $1,404. Wages of year help were highest ($1,608) in central Aroostook and lowest ($1,212) on potato farms outside of Aroostook. In northern Aroostook the average was $1,236 per year and in southern Aroostook $1,296 per year.

Month wages in 1943 averaged $112 and ranged from $92 on potato farms outside Aroostook to $121 on farms in central Aroostook. In northern Aroostook, the month wage rate was $101 and in southern Aroostook $119.

The average day wage rate was nearly $6.00. Day wages varied from less than $4.00 to $10.00 or more. Wages were less than $4.00 per day on 6 per cent of the farms and $10.00 or more on 11 per cent. On nearly half of the farms (49.3 per cent) the

wage rate was $4.00 to $5.99 per day. Day wages were lowest ($4.73) on potato farms outside of Aroostook and highest ($6.82) on farms in central Aroostook.

Wage rates paid for cutting seed potatoes averaged 45 cents per barrel and ranged from less than 30 cents to 60 or more cents. The most common rate was 50 cents per barrel. This was the rate on more than one half (55.6 per cent) of the farms. The rate was less on small farms (44 cents per barrel on farms having less than 40 acres of potatoes per farm) than on large farms (48 cents per barrel on farms having 80 or more acres of potatoes per farm). In northern Aroostook the rate was 40 cents, on potato farms outside Aroostook 43 cents, in southern Aroostook 45 cents, and in central Aroostook 48 cents.

The average cost of picking up potatoes was 17 cents per barrel and the range was from 15 cents to 22 cents. In southern Aroostook and on potato farms outside Aroostook the average cost of picking up potatoes was 16 cents per barrel. In northern Aroostook this cost was 17 cents and in central Aroostook 18 cents.

Seed Potatoes. Of the potato acreage planted on 268 farms furnishing the information, 74 per cent was planted with certified seed in 1944. The percentage planted with certified seed varied from 32 per cent in northern Aroostook to 89 per cent in southern Aroostook. A smaller percentage of the potato acreage on small farms was planted with certified seed than on large farms. On the farms having less than 40 acres of potatoes per farm, 53 per cent of the acreage was planted with certified seed and on the farms having 80 or more acres of potatoes per farm, 88 per cent. The average planting per acre of all seed potatoes on these farms was 9.0 barrels and the average cost of the seed per acre was $42. Plantings of certified seed averaged 9.3 barrels per acre and of seed not certified 8.2 barrels. The average cost of certified seed was $46 per acre and of seed not certified $29 per acre.

Commercial Fertilizer. The average application of commercial fertilizer on the 341 farms that supplied the information was 0.9 ton per acre and the average cost was $44 per acre. The average per-acre application varied but little between the different areas. The per-acre cost, on the other hand, did vary somewhat. This cost was $41 per acre in southern Aroostook, $43 per acre in northern Aroostook, $44 per acre on the potato farms outside of Aroostook, and $45 per acre in central Aroostook.

Mechanical Potato Loader. Mechanical potato-loading equipment adapted to loading potatoes on trucks in the field is one of the more important devices introduced to meet the shortage of labor. These machines were initiated largely by the farmers themselves. Although it is not known how many machines of this nature were in use in 1944, it is known that the number is large and that it has been on the increase.

These loaders or hoists are of two main types, (1) the lever hoist and (2) the cable hoist. In the case of the lever hoist, a hydraulic cylinder operated by a pump lifts a horizontal arm to the end of which is attached a barrel clamp. The cable hoist employs a rope or cable running through a pulley at the end of a horizontal arm and winding on a drum. Power is furnished variously from the motor of the truck, from the truck transmission, from a gasoline engine mounted on the truck, or from an electric storage battery mounted on the truck.

More of the hydraulic type of hoist were observed than of the cable type. The farmers' estimates of the cost of the hoist varied from $175 to $225. Several local companies are now manufacturing mechanical potato-loading equipment.

Production Cost. The average cost of growing and harvesting potatoes on these farms in 1944, computed on the basis that the cost of labor, seed, and fertilizer constitutes two thirds of the growing and harvesting cost, was $207 per acre. The total production cost including the farmers' cost of storing and selling was $271 per acre. The per-barrel cost of growing and harvesting was $2.13. The production cost per barrel including the farmers' cost of storing and selling was $2.79. The cost of production in 1944 was 54 per cent higher than the average of the five years, 1926-1930.

Quality of Inspected Potatoes, 1942 and 1943. The defects recorded for the 25,000 to 35,000 carlots of Maine potatoes inspected annually by the Federal-State Inspection Service indicate the quality of the crop produced.

Potatoes to pass inspection as U. S. No. 1 grade must be free from grade defects except for tolerance allowances. The definition of U. S. No. 1 grade and the tolerance for defects taken from "United States Standards for Potatoes" issued by the U. S. Department of Agriculture, June 1, 1942, is as follows:

"U. S. No. 1 shall consist of potatoes of one variety or similar varietal characteristics which are fairly well shaped, free from freezing injury, blackheart, blight, and soft rot or wet breakdown, and from damage caused by dirt or other foreign matter, sunburn, second growth, growth cracks, air cracks, hollow heart, internal discoloration, cuts, shriveling, sprouting, scab, dry rot, rhizoctonia, other disease, wireworm, other insects or mechanical or other means.

"*Tolerance for defects.*—In order to allow for variations other than size incident to proper grading and handling, not more than 6 per cent of the potatoes in any container may be below the requirements of the grade but not to exceed one-sixth of this amount, or 1 per cent, shall be allowed for potatoes affected by soft rot or wet breakdown. In addition, not more than 5 per cent may be damaged by hollow heart and internal discoloration."

In the potatoes inspected in 1942 and 1943, there were 25 different causes for grade defects recorded. However, 6 of these accounted for two thirds of the damage. Analysis of the 10 per cent sample of the potatoes inspected shows that there was a larger percentage of both external and internal grade defects in 1943 than in 1942. Potatoes out of grade because of external defects in 1942 averaged 3.08 per cent compared with 3.97 per cent in 1943. Comparable figures for internal defects were 1.06 per cent in 1942 and 1.51 per cent in 1943.

Bruises and cuts constituted the chief grade defect in 1942 but in 1943 sunburn caused more grade damage than bruises and cuts. Bruises and cuts in 1942 caused 1.48 per cent of grade defects compared with 1.38 per cent in 1943. Grade defects caused by sunburn in 1942 amounted to 0.68 per cent compared with 1.52 per cent in 1943.

Net necrosis caused 0.99 per cent of grade defects in 1942 and 0.34 per cent in 1943. At the same time, grade defects caused by hollow heart amounted to 0.01 per cent in 1942 and 1.14 per cent in 1943.

Scab and ring rot were each more important in 1942 than in 1943. Late blight infection, on the other hand, was more important in 1943 than in 1942. In 1942 scab caused 0.38 per cent of grade defects compared with 0.13 per cent in 1943. Comparable figures for ring rot were 0.18 per cent in 1942 and 0.07 per cent in 1943. Grade defects caused by late blight infection amounted to 0.06 per cent in 1942 and 0.31 per cent in 1943.

External grade defects in 1942 averaged lowest (2.88 per cent of the potatoes inspected) in the central Aroostook area and highest (4.39 per cent) at inspection points outside of Aroostook. The average of external damage in both northern and southern Aroostook was 3.47 per cent in 1942. In 1943 the percentage of external grade defects in each of the areas was larger than in 1942 but distribution between the areas was similar to that of 1942.

The total percentage of internal defects in 1942 ranged from 0.46 per cent in southern Aroostook to 1.77 per cent for the inspection points outside of Aroostook. In 1943 the percentage range of total internal defects was from 0.88 per cent in northern Aroostook to 3.43 per cent for the inspection points outside of Aroostook. In each of the areas the percentage of internal defects was higher in 1943 than in 1942.

RECENT PUBLICATIONS OF INTEREST TO POTATO GROWERS

Bulletins

No. 427. Early Harvesting of Healthy Seed Potatoes for the Control of Potato Diseases in Maine.

No. 432. Costs and Practices in Producing Potatoes in Southern Aroostook County, Maine, 1941.

No. 434. Treatment of Potato Refuse Piles to Prevent Spread of Late Blight.

Miscellaneous Publications

No. 603. Storage of the 1945 Maine Potato Crop.

Abstracts of Articles Published in Periodicals

TEMPERATURE INHIBITION OF STORAGE DEVELOPMENT OF NET NECROSIS AND "STEM-END BROWNING" OF MAINE POTATOES OF THE GREEN MOUNTAIN VARIETY[15]

In northeastern Maine where Green Mountain potatoes are harvested as soon as possible after maturity, net necrosis (from

[15] This is an abstract of a paper by Donald Folsom having the same title and published in Phytopathology, Vol. 34, No. 12, page 999. 1944.

current-season leafroll infection) and "stem-end browning" (cause undetermined) normally develop only in storage. Their development is maximum and most rapid at about 45° to 50° F., at which temperature the peak usually is reached in 60 to 90 days, and is not influenced by relative humidity. The optimum and maximum temperatures are somewhat higher for stem-end browning than for net necrosis. Development does not occur or is greatly reduced, even at optimum temperatures, if the storage temperature is first held for 60 days at 70° F., which is above the temperature range, or for 30 to 60 days at 32° to 36° F., which is near the lower end of the temperature range. This effect decreases progressively with shorter periods of exposure to the extreme temperatures and as the temperatures approach optimum for necrosis.

POTATO RESISTANCE TO LEAFROLL[16]

In southwestern Maine, with leafroll plants of a commercial variety always in adjacent rows, 70 to 90 per cent of 8,586 seedlings tested in the six years from 1938 to 1943 acquired the disease in one year, as evidenced by symptoms appearing the following year. Similarly exposed healthy plants of the Chippewa and Green Mountain varieties had respectively, 85 and 50 per cent leafroll on the average per year. Among the 5,518 seedlings introduced from 1938 to 1941 inclusive, only 21 are left, most of which are from the cross Imperia x Earlaine. These 21 have remained practically free of leafroll. Leafroll infection has been the basis for elimination of most of the others. When several of these apparently resistant seedlings were crossed with good commercial varieties, the resulting seedlings generally were more vigorous than the resistant parent, and considering all crosses for which they were used, only 55 per cent of these contracted leafroll in the first year of exposure. It seems possible to produce commercially valuable new seedlings resistant enough to leafroll to avoid severe field spread of the disease.

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[16] This is an abstract of a paper by Donald Folsom and F. J. Stevenson having the same title and published in Phytopathology, Vol. 34, No. 12, pages 999-1000. 1944.

THE CONTROL OF POTATO LATE-BLIGHT TUBER ROT[17]

When the late-blight disease is present on potato vines, the late-blight fungus produces spores that may be washed by rain into the soil where they start late-blight rot of the tubers. However, there is generally less danger from this process in Aroostook County than from the spores lodging on the tubers when dug and causing late-blight rot in storage. In 1944 about a tenth of the Aroostook crop rotted in storage because of late-blight rot. In the crop from a field where some late blight was present late in the season, late-blight storage rot took 53 per cent of the tubers dug while the foliage was still mostly green, but only 6 per cent of the tubers dug after the foliage had been killed by frost. Such premature digging had increased late-blight storage rot from none to 20 per cent of the crop in 1942, and from 4 per cent of the crop to 48 per cent in 1943. The necessity of detecting late blight on the foliage late in the season, and of waiting for a killing frost if late blight is present, can be avoided by killing the tops with herbicides (chemical weed killers) about ten days before digging is to be started. Such artificial killing of the tops was followed by no more late-blight storage rot than frost-killing.

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17 This is an abstract of a paper by Reiner Bonde and E. S. Schultz having the same title and published in The American Potato Journal, Vol. 22, pages 163-167, 1945.

APPENDIX

TABLE 1

Ring Rot Occurring after Treating Contaminated Seed Pieces in Solutions of Puratized N5-X for Different Periods of Time and Different Concentrations[1] [2] —1944

Experiment	Treatment	Concentration of solution	Time of treatment	Ring rot developing	Stand	Plant growth
			Minutes	%[3]	%[3]	
1	Inoculated seed pieces treated by dipping in Puratized N5-X solution	1–4310 (2 cc – 1000 cc)	5	42±1.50	78±3.99	Normal
2	do.	1–8620 (1 cc – 1000 cc)	5	68±3.98	82±2.79	do.
3	do.	1–17240 (1 cc – 2000 cc)	5	68±2.80	87±3.33	do.
4	do.	1–4310 (2 cc – 1000 cc)	30	23±3.28	63±3.15	Weak and normal
5	do.	1–8620 (1 cc – 1000 cc)	30	49±2.06	82±3.45	do.
6	do.	1–17240 (1 cc – 2000 cc)	30	58±4.41	83±3.42	Normal
7	do.	1–4310 (2 cc – 1000 cc)	90	14±5.20	42±6.15	Very weak
8	do.	1–8620 (1 cc – 1000 cc)	90	34±6.28	52±4.08	do.
9	do.	1–17240 (1 cc – 2000 cc)	90	45±1.20	72±3.63	Normal
10	Inoculated seed pieces dipped in water	Check No Treatment	5	74±2.21	88±2.73	do.
11	do.	do.	30	78±4.45	79±3.66	do.
12	do.	do.	90	80±3.40	82±3.60	do.
13	Control not dipped in water	do.	—	88±3.31	92±1.68	do.

[1] Supplied by Puratized, Inc., 250 East 43rd Street, New York, N. Y., and said to contain 11.6 per cent toxicant.
[2] Seed pieces contaminated by being dipped in a heavy suspension of the bacteria in water.
[3] Based on five replicated plots of 25 seed pieces for each treatment.

TABLE 2

Ring Rot Occurring after Treating Contaminated Potato Bags with Different Disinfectants—1944

Disinfectants[1]	Concentration of disinfectant	Ring rot developing from inoculating seed pieces with treated sacks		
		Cut surfaces of seed pieces rubbed[2]	Eyes seed pieces pricked[3]	Control. Sacks not treated
		Per cent[4]	Per cent[4]	Per cent[4]
Copper sulphate	1 pound in 10 gallons water	2	4	100
do.	2 pounds in 10 gallons water	0	2	100
do.	4 pounds in 10 gallons water	0	0	100
do.	6 pounds in 10 gallons water	0	0	100
Copper sulphate and saturated salt solution	2 pounds copper sulphate in 10 gallons water saturated with table salt	0	0	80
Coal Tar Dip Phenol Coefficient 6	1 gallon in 100	0	0	60
	2 gallons in 100	0	0	70
	4 gallons in 100	0	2	80
Formaldehyde	1 pint in 40 gallons	0	4	70
do.	2 pints in 40 gallons	0	0	70
do.	3 pints in 40 gallons	0	0	
do.	4 pints in 40 gallons	0	0	
Table salt	4 pounds in 10 gallons water	2	6	70
do.	8 pounds in 10 gallons water	2	4	80
do.	16 pounds in 10 gallons water	4	4	100
Corrosive sublimate	4 ounces in 30 gallons water	0	0	100

[1] Pieces of burlap potato bags were severely contaminated with the ring-rot organism taken directly from infected potatoes. The pieces of bags were soaked for 5-minute periods in the different disinfecting solutions before being used to inoculate freshly cut potato seed pieces.

[2] Freshly cut surfaces of potato seed pieces were rubbed with the pieces of treated bags and then planted in the greenhouse.

[3] The treated pieces of contaminated bags were moistened with water, the excessive water was squeezed from the bags, and a drop pricked into the eyes of the seed pieces with sterilized needles.

[4] Based on reading from 50 inoculated seed pieces planted in the greenhouse.

TABLE 3

Ring Rot Resulting from Inoculating Freshly Cut Seed Pieces with Pieces of Contaminated Burlap Bags Stored at Different Temperatures for Different Periods of Time[1]

Storage condition of pieces of sack	Percentage ring-rot plants resulting from inoculations		
	After 115 days[2]	After 334 days[3]	After 483 days[4]
	Per cent	Per cent	Per cent
Outside[5]	22	12	4
30° F.[6]	100	48	12
32° F.[6]	44	38	20
36° F.[6]	72	0	0

[1] Burlap potato bags were cut into 12-inch square pieces and contaminated by being smeared with decay from infected tubers. They were placed at the different storage conditions February 18, 1943 and were used for inoculating the seed pieces June 12, 1943 (after 3 months and 25 days), January 18, 1944 (after 11 months and 4 days) and on June 15, 1944 (after 1 year, 3 months and 28 days).
[2] Percentage infection based on disease reading from 50 inoculated seed pieces planted in the field.
[3] Percentage infection based on disease reading from 250 inoculated seed pieces planted in the greenhouse.
[4] Percentage infection based on disease reading from 100 inoculated seed pieces planted in the field.
[5] Contaminated pieces of sack fastened to wall on north side of barn.
[6] Controlled temperature chambers at Aroostook Farm, Presque Isle, Me.

TABLE 4

Ring Rot Resulting from Inoculating Freshly Cut Seed Pieces with Pieces of Contaminated Potato Bags Stored for 11 Months at 32° F.[1]

Sack No.	Method of inoculation	
	Cut surfaces of seed pieces rubbed[2]	Eyes of seed pieces pricked[3]
	Per cent[4]	Per cent[4]
31	50	90
32	50	90
33	40	100
34	50	80
35	0	70

[1] Pieces of burlap bags were contaminated by smearing with infected potato tissue and placed in controlled temperature storage bins February 18, 1943 until January 18, 1944.
[2] Freshly cut surfaces of the seed pieces were inoculated by being rubbed with the contaminated pieces of bags.
[3] The pieces of contaminated burlap bags were moistened with water. The excessive water was squeezed from the bag and a drop pricked into eyes of the seed pieces with sterilized needles.
[4] Based on 50 inoculated seed pieces for each treatment.

TABLE 5

Comparison of Ring Rot Resistance in Different Commercial and Seedling Varieties—1944[1]

Variety	Ring rot occurring		Severity of decay in tubers
	Plants	Tubers	
	Per cent[2]	Per cent[3]	
Green Mountain	95	95.0	Severe and tubers badly disintegrated
Katahdin	72	68.2	Severe. Many tubers, however, intact and firm
Sebago	51	45.3	do.
President	2[4]	14.8	Very slight
S. 47102	18[4]	15.2	Very slight
S. 46952	2[4]	31.8	Slight. More severe than for President and 47102
S. 870[5]	1[4]	0.0	None
S. 824[6]	4[4]	0.0	None

[1] The freshly cut surfaces of seed pieces were inoculated by being dipped in a heavy water suspension of the bacteria. Planted immediately in the field.
[2] Percentages based on 10 replicated lots of 10 seed pieces each for the different varieties.
[3] Infection found on cutting and examining the tubers harvested from the inoculated plants after they had been in storage for five months.
[4] Symptoms not definitely ring rot but plants suspected as having the disease.
[5] Resistant seedling selected in 1942 and tested again in 1943 and 1944. Parentage Earlaine x 336-144.
[6] Resistant seedling selected in 1942 and tested again in 1943 and 1944. Parentage Houma x 336-144.

TABLE 6

Ring Rot Resistant Seedlings in Different Progenies Inoculated in the Field in 1944. Ring Rot in Controls and Parents of Progenies Included for Comparison[1]

Variety or Cross	U.S.D.A. Pedigree No.	Number seedlings tested	Number controls and parent lots tested	Resistant seedlings or lots	
				Number[2]	Percentage
Katahdin controls			169	0	0
Sebago			5	0	0
46952			5	5	100.0
Green Mountain			5	0	0
Houma			5	0	0
Earlaine			5	0	0
Earlaine #2			5	0	0
47156			5	0	0
96-44			5	2	40.0
96-56			5	0	0
96-28			5	0	0
336-144			5	5	100.0
President			100	100	100.0
96-28 x 336-144	B-345	20		8	40.0
96-44 x 336-144	B-351	77		41	53.2
96-56 x 336-144	B-355	62		22	35.5
President x 96-28	B-273	117		43	36.8
President x 47156	B-274	108		60	55.6
President x Katahdin	B-275	103		34	33.0
Earlaine x 336-144	B-319	57		21	36.8
Green Mountain x 336-144	B-282	84		39	46.4
Houma x 336-144	B-296	67		33	49.3
Sebago x 46952	B-311	53		3	5.7
Earlaine x 46952	B 320	49		27	55.1
Earlaine #2 x 46952	B-327	9		1	11.1
46952 x Katahdin	B-433	5		2	40.0
46952 x 336-144	B-434	92		49	53.3
336-144 Selfed	B-1080	23		19	82.6
46952 Selfed	B-1081	14		10	71.4
President Selfed	B-1103	127		69	54.4

[1] Five seed pieces of each seedling inoculated by being dipped in a heavy suspension of the bacteria and planted immediately in the field.
[2] Showed no ring rot symptoms in foliage or in tubers at time of harvest.

TABLE 7

Comparison of the Prevalence of Potato Ring Rot in One Town for the Years 1941, 1943, and 1944[1]

	1941	1943	1944
Number of farms visited	146	103	62
Number of farms visited having ring rot	98	42	19
Per cent of farms visited having ring rot	67.1	40.8	30.7
Number of fields visited	463	172	80
Number of fields visited having ring rot	164	51	19
Per cent of fields visited having ring rot	35.4	29.7	23.7
Total number of acres inspected	5338.5	2486	1513
Number of acres, in fields inspected, having ring rot	1843.1	676	278
Per cent of total acreage, in fields inspected, having ring rot	40.9	27.2	17.9

[1] The data from which this summary is derived were secured by examination of the fields during the time the crop was being harvested.

TABLE 8

Prevalence of Ring Rot in the Different Varieties of Potatoes in One Town During the Years 1941, 1943, 1944

Variety	Total acres examined		Acres in fields with ring rot		Per cent of total acreage in fields with ring rot		
	1943	1944	1943	1944	1941	1943	1944
Katahdin	1027.0	410.0	336.0	54.0	33.9	32.7	13.2
Chippewa	529.7	502.0	156.0	164.0	58.8	29.5	32.7
Green Mountain	473.5	480.0	155.0	55.0	30.5	32.7	11.5
Irish Cobbler	282.6	101.0	10.0	00.0	17.1	3.5	0.0
Sebago	137.0	5.0	0.0	0.0	14.7	0.0	0.0
Houma	32.0	15.0	5.0	5.0	0.0	15.6	33.3
Spaulding Rose	4.0	0.0	0.0	0.0	0.0	0.0	—
Totals	2485.8	1513.0	662.0	278.0			

TABLE 9

Amount of Ring Rot in One Town During the Years 1943 and 1944

Tubers infected	Acres in infected fields					
	Number acres	Per cent of total acreage examined	Per cent of infected acreage examined	Number acres	Per cent of total acreage examined	Per cent of infected acreage examined
	1943			1944		
Trace	456.0	18.3	67.5	207	13.7	74.5
0.1 to 0.9%	54.0	2.2	8.0	9	0.6	3.2
1.0 to 5.0%	143.5	5.8	21.2	27	1.8	9.7
6.0 to 9.0%	0.0	0.0	0.0	35	2.3	12.6
10.0 to 25.0%	22.0	0.9	3.3	0	0.0	0.0
26% and over	1.3	trace	0.01	0	0.0	0.0
Total infected	676.0	27.2	100.0	278	18.4	100.0
Total not infected	1810.0	72.8	0.0	1235	81.6	0.0
Total examined	2486.0	100.0	—	1513	100.0	—

TABLE 10

Source of Potato Seed Used in Fields Showing Ring Rot in One Town

Seed source Grower No.	Number of fields infected	Acreage	Per cent of total acreage
1	4	71	25.54
2	2	15	5.39
3	2	37	13.31
4	1	35	
5	1	30	
6	1	22	
7	1	18	
8	1	14	
9	1	10	55.76
10	1	6	
11	1	5	
12	1	5	
13	1	5	
14	1	5	
Totals	19	278	100.00

TABLE 11

Control Practices in Relation to Ring-Rot Infection Among Seed Plot Growers of the Farm Security Administration Program in the Vicinity of Frenchville and Caribou, Maine

Area	Number growers	Planted seed plot first	Dug seed plot first	Disinfected or new:			
				Planter	Barrels	Bin	Digger
Caribou	20	9	8	11	5	4	5
Frenchville	14	9	9	4	10	4	4
Totals	34	18	17	15	15	8	9

TABLE 12

Summary of Ring Rot Survey of Farm Security Administration Seed Plots Located Near Caribou and Frenchville

Number growers	Area	Seed Plot		Commercial field	
		Ring rot	Free of Ring rot	Ring rot	Free of Ring rot
20	Caribou	3	17	14	6
14	Frenchville	4	10	13	1
34		7	27	27	7

TABLE 13

Comparison of Highmoor Farm Leafroll-Resistant Potato Seedlings on Aroostook Farm 1944

Variety or seedling	Plots	Stems per hill	Oz. per tuber	Lbs. per hill	Bbls. per acre[1]	Bu. per acre[1]	Predominant tuber type[2]
Green Mt.	11	3.7	3.23	1.43	126	346	4
X750-10M[3]	10	3.7	2.03	1.14	100	275	1, thin
X750-10[4]	10	2.8	2.08	1.08	89	244	1
X1276-48[5]	10	1.9	2.62	.81	66	180	1, 4
X1276-185	5	3.7	2.69	1.11	97	266[6]	4
X247-24	10	1.8	2.61	.52	45	123	4
X247-30[7]	1	2.9	1.88[8]	.77	62	171	Most poor; some spindle tuber
X247-42	1	4.0	1.52[8]	.83	73	202	Flat, round, thin
X247-48[9]	5	2.1	2.78	.68	46	125	4
B24-9	1	5.0	1.59	1.08	95	262[6]	6
B24-50[10]	10	1.7	3.53	.62	51	141	1
B24-58	10	5.1	2.04	1.26	110	304	1, 4, 5
B24-76[11]	10	3.6	1.78	1.10	95	262[6]	1
B24-78	5	5.8	1.77	1.29	110	304	4, 5, 6
B24-91	1	5.0	1.54[8]	1.08	95	262[6]	Like Irish Cobbler
B24-156	1	4.7	1.78[8]	.79	70	192[6]	Like I.C. but thinner
B24-174	1	5.5	1.50[8]	1.09	88	242[6]	Like Irish Cobbler
B24-190	1	3.4	1.70[8]	.96	84	232[6]	Like I.C. to Chippewa
B24-238	10	3.2	2 00	1.11	97	266	1
B24-304	1	3.8	1.31[8]	.71	62	171[6]	Like Irish Cobbler

[1] Chippewas yielded 82% as much as Green Mountains elsewhere on Aroostook Farm, which would be equivalent to 103 barrels or 284 bushels an acre here.
[2] Number of tuber type same as in Fig. 17 of Me. Agr. Exp. Sta. Bul. 358.
[3] Early harvested; free of latent mosaic.
[4] 4 per cent leafroll.
[5] (X1276-48) with some weak hills, which had Rhizoctonia desprouting.
[6] Dead or nearly so first part of September
[7] (X247-30), mostly spindle-tuber.
[8] With no tubers weighing as much as 6 oz.
[9] (X247-48) with weak hills, which had seed-piece rot.
[10] (B24-50) mostly spindle-tuber.
[11] (B24-76) 1 per cent leafroll.

TABLE 14

Correlations Between Characteristics of Series of Seedlings of Table 13

Comparison	r	Significant?[1]
Stems per hill and tubers per hill	+.873	Highly
Stems per hill and average tuber weight	—.647	Highly
Stems per hill and weight of hill	+.669	Highly
Tubers per hill and average tuber weight	—.789	Highly
Tubers per hill and weight of hill	+.739	Highly
Weight of hill and number of plants per plot	+.460	Yes
Weight of hill and yield rate per acre	+.992	Highly
Weight of hill and average tuber weight	—.186	No
Number of plants per plot and yield rate per acre	+.559	Highly
Number of plants per plot and tubers per hill	+.405	No
Average tuber weight and yield rate per acre	—.185	No

[1] According to tables in No. 4 of Vol. 30 of Iowa State College of Agriculture and Mechanic Arts Official Publication. (Wallace, H. A., and George W. Snedecor, Correlation and machine calculation, revised by G.W.S. 1931.)

TABLE 15

Leafroll Reaction of New Seedlings

Pedigree No.	Tubers planted	Hills growing	Hills showing leafroll symptoms resulting from current season infection	Hills saved for further testing
B507	238	233	194	39
B511	133	110	83	24
B512	206	193	143	50
B517	284	271	206	65
B518	164	154	116	38
B522	370	352	224	128
B1113	527	471	60	411

TABLE 16

Stem-end Browning and Net Necrosis in Tubers from Permanent Plots, Aroostook Farm, 1944

Stored at least 3 months at 50° before cutting. Per cent S.E.B. calculated on basis of Net Necrosis-Free Tubers*

Plot No.	Fertilizer Treatment 2000# per acre unless otherwise stated	Tubers with Net Necrosis	Per cent of tubers free of NN having S.E.B.		
			Severe[1]		Total S.E.B.
			Av.	Range[2]	
	Rate of application				
211	No fertilizer	16.2	0	—	1.0
237	1500 lbs.	17.0	6.5	2-16	18.2
231	2000 lbs.	35.3	5.3	3-8	26.3
245	2500 lbs.	42.2	8.2	2-19	24.4
257	3000 lbs.	35.1	11.3	7-17	24.2
	Fertilizer Ratios				
213	0-8-8	18.3	*7.6*	2-15	16.2
233	2-8-8	23.1	*10.4*	3-18	31.0
231	4-8-8	35.3	*5.3*	3-8	26.3
223	6-8-8	27.7	*5.2*	0-10	22.2
214	4-0-8	18.6	4.1	1-6	15.3
244	4-4-8	22.0	6.0	1-22	25.4
231	4-8-8	35.3	5.3	3-8	26.3
234	4-12-8	42.1	8.3	4-13	31.6
215	4-8-0	19.4	.4	0-1	1.9
225	4-8-4	25.3	1.2	0-2	7.3
231	4-8-8	35.3	5.3	3-8	26.3
216	4-8-10	36.2	11.1	1-25	33.4
235	4-8-12	34.7	17.2	11-34	39.1
	Muriate versus Sulfate of Potash				
227	KCl unlimed ½	25.3	7.1	4-10	22.9
	KCl limed ½	22.6	10.9	4-20	31.7
	Average	24.0	9.0		27.3
217	K_2SO_4 unlimed ½	18.2	4.0	2-9	14.1
217	K_2SO_4 limed ½	21.8	2.2	0-7	19.3
	Average	20.0	3.1		16.7

* On basis of 800 to 1200 tubers per plot. One-bushel samples from each of 6 rows averaged together. Rows 1, 2, and 3 planted with strain of Green Mountain less susceptible to S.E.B. development. Rows 4, 5, and 6 planted with susceptible strain. All 6 rows averaged together in this table.

[1] Severe stem-end browning—discoloration ¼" deep or deeper—of *economic importance*.

[2] Range—lowest and highest percentage in six boxes.

TABLE 17

Effect of Fertilizer Treatment on Stem-end Browning and Net Necrosis in Tubers Grown on Soil Which Had Not Been Previously Fertilized

Treatment No.	Fertilizer Treatment	Acre Yield	Net Necrosis	Stem-end Browning based on net-free tubers	
				Severe	Total
		Bu.	%	%	%
1	2500# 4-8-8 equivalent of Urea, NH_4PO_4 and KNO_3	286	33	6	20
2	Same as No. 1 plus 10# borax	268	32	5	22
3	Same as No. 1 plus 500# salt (NaCl)	285	39	16	40
4	Same as No. 3 plus 10# borax	309	39	14	34
5	2500# 4-8-8 with KCl as source of potash	282	41	12	27
6	3500# 4-8-8 with KCl as source of potash	291	34	8	20
7	2500# 4-8-8 with K_2SO_4 as source of potash	315	38	7	22
8	3500# 4-8-8 with K_2SO_4 as source of potash	338	38	8	36
9	No. 7 with NaCl equivalent to Cl in No. 5	301	45	15	28
10	No. 8 with NaCl equivalent to Cl in No. 6	282	40	13	32
11	No. 6 plus 50# copper sulfate	290	32	11	26
12	2500# 4-8-0	255	35	4	13
13	No fertilizer	88	25	4	22

Yield data based on five replicated plots of each treatment.
S.E.B. and N.N. data based on three bushel box samples.

TABLE 18

Effect of Borax Glass in Potato Fertilizers on Yield and on Development of Net Necrosis and Stem-end Browning

Amount and kind of fertilizer	Amount and Source of boron	Acre yield		Net[1] Necrosis	Stem-end Browning based on net-free tubers	
					Sev.[2] SEB	Total SEB
		Bu.	Bbl.	%	%	%
2000 pounds 5-7-10 with K_2SO_4 as source of potash	None	371	135	24	45	80
	75# borax glass 702 AP	175	64	25	5	59
	150# borax glass 702 AP	128	47	31	8	54
	75# borax glass 702 AQ 80 mesh	234	85	20	8	62
	150# borax glass 702 AQ 80 mesh	171	62	18	11	56

[1] Net necrosis and stem-end browning readings based on examination of sample of 200 to 300 tubers which had been stored for three months at 50° F.
[2] Severe stem-end browning refers to a discoloration that extended ¼ or more inches into the tuber.

TABLE 19

Effect of Boron in Potato Fertilizers on Yield and on Development of Net Necrosis and Stem-end Browning

Amount and kind of fertilizer	Amount and Source of boron	Acre yield Bu.	Acre yield Bbl.	Net[1] Necrosis %	Stem-end Browning based on net-free tubers: Sev.[2] SEB %	Stem-end Browning based on net-free tubers: Total SEB %
2000 pounds 5-7-10 KCl as source of potash	None	356	129	33	6	47
	10# borax	317	115	32	6	36
	25# borax	279	101	21	7	37
	75# Spent boron Catalyst	296	108	28	6	40
	150# Spent boron Catalyst	271	98	32	6	32
2000 pounds 5-7-10 K_2SO_4 as source of potash	None	367	133	18	2	21
	10# borax	318	116	25	2	27
	25# borax	275	100	35	12	36
	75# Spent boron Catalyst	298	108	27	9	31
	150# Spent boron Catalyst	243	88	17	3	25

[1] Net necrosis and stem-end browning readings based on examination of samples of about 400 tubers which had been stored for three months at 50° F.
[2] Severe stem-end browning refers to a discoloration that extended ¼ or more inches into the tuber.

TABLE 20

Effect of Date of Planting on Net Necrosis
Aroostook Farm, 1944

Green Mountains

Seed	Date planted	Net necrosis at different digging dates[3]: August 26[4] %	September 9[5] %	October 7[6] %	All %
Keswick[1]	May 16	0.5	2.5	9.4	3.8
	May 31	12.0	27.9	25.6	21.8
	June 15	24.3	38.7	18.9	27.8
Minnesota[2]	May 16	0.3	7.7	7.0	4.9
	May 31	5.1	16.3	18.7	13.6
	June 15	9.2	30.4	18.1	19.2

[1] Highly susceptible to stem-end browning.
[2] Fairly resistant to stem-end browning.
[3] Tubers stored immediately at 50° F. and examined after 100 or more days at this temperature. Except for the last column, all figures are the averages of 3 replicates, each 32 feet long. For yields, see Table 25.
[4] Tops pulled August 23.
[5] Tops pulled September 9.
[6] Tops killed by freeze on September 24.

TABLE 21

Net Necrosis and Stem-end Browning in 13 Different Experimental Plantings Grouped According to Planting Date Aroostook Farm, 1944

Green Mountains — Dug between Sept. 27 and Oct. 8

Planting date	Number of experimental plantings	Net necrosis[1]	Stem-end browning[1]	
			Resistant strains	Susceptible strains
		%	%	%
May 18	3	9.2	9.9	36.3
May 31–June 1	6	22.0	12.3	34.4
June 6–7	4	39.0	20.9	45.7

[1] Tubers examined after storage for 100 or more days at 50° F. The figures are the averages of the designated number of experimental plantings, each consisting of at least 25 one-row plots, 29 feet in length.

TABLE 22

Fertilizer Ratio and Rate of Application on Permanent Plots in Relation to Net Necrosis and the Spread of Leafroll Aroostook Farm, 1943

Green Mountains — 3-Year Rotation

Treatment	Rate	Net necrosis[2]	Total leafroll[3]	Net necrosis: leafroll ratio (X100)
	Lbs./A.	%	%	
No fertilizer	0	0.4	2.5	16
4-8-8	2000	5.0	9.1	55
4-8-8	3000	11.5	18.3	63
0-8-8	2000	2.7	4.0	68
2-8-8	2000	5.5	9.2	60
4-8-8	2000	5.0	9.1	55
6-8-8	2000	1.8	5.5	33
4-0-8	2000	1.8	4.3	42
4-4-8	2000	3.7	7.6	49
4-8-8	2000	5.0	9.1	55
4-8-12	2000	8.4	14.6	58
4-8-0	2000	0.3	3.2	9
4-8-4	2000	6.2	11.8	53
4-8-8	2000	5.0	9.1	55
4-8-12	2000	3.4	7.1	48
4-8-8 (CP[1]+Mg)	2000	4.3	6.4	67
4-8-8 (CP[1]+B)	2000	3.7	6.8	54
4-8-8 (CP[1])	2000	3.0	10.0	43
4-8-8 (KCl)	2000	9.3	12.5	74
4-8-8 (KCl–limed)	2000	6.8	11.0	62
4-8-8 (K_2SO_4)	2000	1.7	4.9	35
4-8-8 (K_2SO_4–limed)	2000	4.6	6.7	69

[1] Fertilizer mixture prepared from chemically pure salts.
[2] Tubers examined after storage for 100 days or longer at 50° F.
[3] Field readings on 1943 crop replanted in 1944.

TABLE 23

Susceptibility of Green Mountains Obtained from Various Foundation Growers to Stem-end Browning Aroostook Farm, 1944

Plot No.	Lot No.	Strain	Stem-end browning[4]	
			Severe	Total
			%	%
	1	Keswick	23.9	36.3
	2	Unknown	13.7	21.5
	3	Highmoor	4.1	6.4
1	4	Highmoor	6.7	7.4
	5	Vermont	7.7	9.7
	6	Unknown[1]	6.2	8.7
	1	Keswick	20.6	30.9
	7	Keswick(?)[2]	14.6	25.7
	8	Vermont	5.4	7.5
2	9	Phillips	5.7	8.5
	10	Phillips	4.1	5.6
	6	Unknown[1]	4.5	6.1
	1	Keswick	45.1	52.9
	11	Keswick	36.9	49.4
3	12	Unknown[3]	21.8	27.5
	6	Unknown[1]	9.4	15.4

[1] Lot No. 6 was obtained from Minnesota and was included in all plots as a typical resistant strain.
[2] Origin not certain, but is probably Keswick strain.
[3] Previous experience with this lot indicated that it was a mixture of strains.
[4] The figures for plots 1 and 2 are the averages of 6 replicates, each 29 feet long, from a 6 x 6 Latin Square. Those for plot 3 are the averages of 5 replicates, each 29 feet long.

TABLE 24

Effect of Date of Planting on Stem-End Browning and on Yield
Aroostook Farm, 1944

Green Mountains

Seed	Date planted	Yield at different digging dates[3]						Stem-end browning at different[3 4] digging dates			
		August 26[5]		September 9[6]		October 7[7]		August 26	September 9	October 7	All
		Bbl./A.	Bu./A.	Bbl./A.	Bu./A.	Bbl./A.	Bu./A.	%	%	%	%
Keswick[1]	May 16	81.0	222.8	105.3	289.6	118.9	327.0	15.1	13.1	32.7	19.4
	May 31	58.7	161.4	88.3	242.8	96.6	265.7	27.6	26.0	50.3	34.4
	June 15	27.7	76.1	62.6	172.2	74.3	204.3	38.5	33.1	46.5	35.2
Minnesota[2]	May 16	80.0	220.0	112.1	308.3	140.2	385.6	7.4	4.7	9.7	7.3
	May 31	50.2	138.1	95.6	262.9	101.4	279.9	26.9	16.8	19.5	20.8
	June 15	43.2	118.8	57.7	158.7	70.9	195.0	25.3	17.3	28.8	30.7

[1] Highly susceptible to stem-end browning.
[2] Fairly resistant to stem-end browning.
[3] Figures in all except the last column are the averages of 3 replicates, each 32 feet long.
[4] Tubers were stored immediately at 50° F. and examined after storage for 100 or more days at that temperature.
[5] Tops pulled August 23.
[6] Tops pulled September 9.
[7] Killing freeze on September 24.

TABLE 25

Effect of Adding Calomel to the Fertilizer

Keswick Green Mountains

Digging Date	Treatment[4]	Net necrosis[5]	Stem-end browning[5]	
			Severe	Total
		%	%	%
August 26[1]	1600# 6-9-15/A.	1.3	25.9	34.1
	1600# 6-9-15/A. plus 5# HgCl	2.3	14.5	23.2
September 9[2]	1600# 6-9-15/A.	7.2	11.2	19.4
	1600# 6-9-15/A. plus 5# HgCl	9.6	5.3	10.8
September 27[3]	1600# 6-9-15/A.	13.0	6.8	11.8
	1600# 6-9-15/A. plus 5# HgCl	18.0	7.6	13.7

[1] Tops pulled August 23.
[2] Tops pulled September 9.
[3] Killing frost September 24.
[4] Band placement. Calomel was mixed with the fertilizer before application.
[5] Averages of 6 replicates, each 29 feet long, from a 6 x 6 Latin Square. Tubers examined after storage for 100 or more days at 50° F.

TABLE 26

Effect of Adding Varying Amounts of Calomel to the Fertilizer on Yield, Net Necrosis and Stem-end Browning

Green Mountain

Seed	Pounds of calomel per acre[3]	Pounds of mercury per acre	Yield[4]		Net necrosis[4]	Stem-end browning[4]	
						Severe	Total
			Bbl./A.	Bu./A.	%	%	%
Minnesota[1]	0	0	123.0	338	30.8	12.3	17.4
	5	4.25	114.7	315	34.5	6.8	10.1
	10	8.50	116.6	321	32.5	2.8	5.7
	15	12.75	108.9	300	27.5	3.9	6.1
	25	21.25	105.4	290	27.6	2.8	5.9
Keswick[2]	0	0	126.9	349	30.1	33.1	46.9
	5	4.25	124.0	341	35.8	21.3	34.4
	10	8.50	122.1	336	36.7	24.1	39.2
	15	12.75	120.8	332	38.0	19.9	36.8
	25	21.25	124.3	342	32.7	15.4	34.8

[1] Fairly resistant to stem-end browning.
[2] Highly susceptible to stem-end browning.
[3] The calomel was mixed well with a 6-9-15 commercial fertilizer applied in bands in the usual manner. The mixture was applied at a rate equivalent to 1600 pounds per acre of the 6-9-15 fertilizer. Band placement.
[4] The figures in these columns are the averages of 5 replicates, each 29 feet long, from a double-row 5 x 5 Latin Square. The tubers were examined for net necrosis and stem-end browning after storage for 100 days or longer at 50° F.

TABLE 27

Transmission of Susceptibility to Stem-end Browning by Tuber Grafts Aroostook Farm, 1943-1944

Green Mountains

1943 seed	Plot 1[2]				Plot 2[3]			
	1943 crop		1944 crop[4]		1943 crop		1944 crop[4]	
	No. tubers	Stem-end browning[5]	No. tubers	Stem-end browning[5]	No. tubers	Stem-end browning[5]	No. tubers	Stem-end browning[5]
		%		%		%		%
Minnesota (not grafted)	48	6.3	373	9.4	287	2.8	733	13.8
Plug of Keswick grafted into Minnesota seed piece[1]	42	28.6	362	29.8	329	15.2	731	21.1
Keswick (not grafted)	22	22.7	388	36.6	285	26.7	740	39.3

[1] Care was taken to use plugs without eyes.
[2] In 1943 the tuber units from this plot were kept separate. About 50% of the grafted units produced more stem-end browning than the corresponding Minnesota controls. Only those thus showing an indication of transmission are here reported as the 1943 crop. The same units were the only ones replanted in 1944.
[3] Tuber units were not kept separate; the figures shown are plot averages.
[4] The 1943 crop was used for seed in 1944.
[5] Tubers were examined after storage for 100 or more days at 50° F.

TABLE 28

Minor Elements Added to the Fertilizer in Relation to Yield, Stem-end Browning and Net Necrosis

Green Mountains, Keswick Strain

Treatment Band Placement	Yield[4]		Net necrosis[4]	Stem-end browning[4]	
				Severe[5]	Total
	Bbl./A.	Bu./A.	%	%	%
1600# 6-9-15[1] per acre	137.8	379	26.9	48.1	56.6
1600# of 6-9-15[1] plus 5# Co per acre	96.7	266	25.1	43.0	55.9
1600# of 6-9-15[1] plus 2# Y per acre	115.3	317	37.8	42.4	47.6
1600# 6-9-15[1] per acre plus mixture[2]	122.1	336	26.5	43.4	52.7
1000# Milorganite[3] per acre	131.1	361	31.4	49.5	55.5
Difference required for significance					
5% level	19.4	53.4			
1% level	27.2	74.7			

[1] Commercial mixture KCl as source of potash.
[2] One pound per acre of each of the following: yttrium, lanthamum, cerium, neodymium, thorium, and uranium. Also 0.42 pound per acre of rubidium and 0.66 pound per acre of cesium. All applied as nitrate or chloride.
[3] 1000 pounds per acre of Milorganite plus sufficient 6-9-15, KCl, superphosphate and sea water magnesia to make the application equivalent to 1600 pounds per acre of 6-9-15.
[4] The figures in these columns are the averages of 5 replicates, each 29 feet long, from a 5 x 5 Latin Square.
[5] Considered to be of commercial importance.

TABLE 29

Effect of Strontium and of Es-Min-El on Yield, Net Necrosis and Stem-end Browning
Aroostook Farm, 1944

Green Mountains

Treatment[1]	Yield[4] per acre		Net necrosis[5]	Stem-end browning[5]	
				Severe	Total
	Bbl.	Bu.	%	%	%
Control	150.0	412	42.2	17.9	20.1
1 lb. Sr/A.	143.3	394	43.4	18.3	20.7
2 lbs. Sr/A.	143.5	395	49.2	17.8	20.4
5 lbs. Sr/A.[2]	146.5	403	41.0	16.5	20.7
10 lbs. Sr/A.	154.1	424	43.5	17.5	20.3
50 lbs. Es-Min-El[3]/A.	145.4	400	55.2	13.3	16.3
100 lbs. Es-Min-El/A.	138.7	381	42.5	16.0	19.0
Control	150.4	414	42.0	14.9	18.8
Minimum difference required for significance 5% level	11.7	32.1			

[1] 1600 lbs. of a 6-9-15 commercial fertilizer per acre were applied in all cases.
[2] 1 replicate missing.
[3] A product of the Tennessee Corporation; reported to contain Mn, Zn, Cu, Fe, Mg, B, and Co.
[4] Average of 8 replicates, each 50 ft. long, from an 8 x 8 Latin Square.
[5] Average of 5 replicates, each consisting of 1 bushel, taken from 5 blocks of the Latin Square. Tubers were examined after storage for 100 days or longer at 50° F.

TABLE 30

Weeds in Wasteland as Aphid Hosts, at Presque Isle, Listed in Order of Importance on Each Aphid

Aphid Species	Weeds			
	Apterous form		Alate form	
	1943	1944	1943	1944
	Species of weeds (All age groups combined)			
A. abbreviata	Hemp nettle Smartweed Wild radish[1] Wild rutabaga[1]	Smartweed Hemp nettle Wild rutabaga	Smartweed Wild radish Hemp nettle Wild rutabaga	Wild radish Smartweed Lamb's-quarters Wild rutabaga
M. persicae	Wild radish Wild rutabaga	Wild radish Wild rutabaga	Wild radish Wild rutabaga	Wild radish Wild rutabaga
M. solanifolii	Hemp nettle Smartweed Wild radish Wild rutabaga Lamb's-quarters	Wild radish Smartweed Hemp nettle Wild rutabaga	Wild rutabaga Wild radish Hemp nettle Smartweed Lamb's-quarters	Wild radish Smartweed Wild rutabaga Hemp nettle
All species combined	Wild radish Hemp nettle Wild rutabaga Smartweed Lamb's-quarters	Wild radish Wild rutabaga Hemp nettle Smartweed Lamb's-quarters	Wild rutabaga Wild radish Hemp nettle Smartweed Lamb's-quarters	Wild radish Wild rutabaga Hemp nettle Smartweed Lamb's-quarters

[1] Locally wild radish is known as kale and wild rutabaga as mustard.

TABLE 31

The Average Number of Wingless Myzus persicae and solanifolii per Plant Sample on Different Sampling Dates. Randomized Block, Population-levels Experiment. Aroostook Farm, Presque Isle, Maine, 1944

Date	Population Levels					
	Low		Intermediate		High	
	Mp*	Ms*	Mp	Ms	Mp	Ms
7/7	.007	0	.04	.020	0	0
7/12	.013	0	.007	.007	0	0
7/20	.186	.020	.067	.067	.180	.013
8/1	.927	.186	.913	.140	1.340	.047
8/3	1.733	.207	2.613	.207	4.420	.267
8/7	8.660	.853	8.893	.380	11.760	.720
8/9	1.488	.016	7.040	.656	14.976	.992
8/14	19.100	.680	39.800	3.660	40.030	2.210
8/16	2.040	.056	11.392	1.328	23.904	1.896
8/22	21.336	.992	115.032	5.800	153.648	8.832
8/25	6.511	.444	46.612	4.722	142.967	8.663
8/30	16.400	1.693	25.813	9.040	194.040	21.093

* Mp = *Myzus persicae* (green peach aphid).
Ms = *Macrosiphum solanifolii* (potato aphid).

TABLE 32

Yields of Tubers in Plots with Different Levels of Aphid Populations at Aroostook Farm, Presque Isle, 1944. Katahdin Variety

Population Level	Pounds per plot[1]		Bushels per Acre		
	U.S. No. 1 Grade	U.S. No. 2 and Peewees	U.S. No. 1 Grade	U.S. No. 2 and Peewees	Total yield
High	2904.5	341.5	272.0	32.0	304.0
Intermediate	3283.0	263.7	307.5	24.7	332.2
Low	4104.7	231.5	384.4	21.7	406.1

[1] Yields are the total from 18 randomized plots of 4 rows, each 38 feet in length.

TABLE 33

Leafroll Control Experiment—Survival of Three Species of Aphids on Potato Following Spray or Dust Applications at Four Farms
Houlton, Maine, 1944

(Plots at Farm No. 1 sprayed 4 times; at Farm No. 2 and Farm No. 3 dusted 4 times; at Farm No. 4 dusted 3 times)

Date	Farm	Number of living aphids per 99 leaves								% reduction in infestation
		A. abbreviata		*M. solanifolii*		*M. persicae*		Total aphids		
		Derris	Check	Derris	Check	Derris	Check	Derris	Check	Derris
7/3	No. 1		4		0		1		5	
7/11			5		0		2		7	
7/19			7		1		3		11	
7/24		10	11	5	9	1	3	16	23	30
8/2		14	16	4	13	7	17	25	46	46
8/8		56	151	37	123	106	405	199	679	71
Av. % reduction		55		68		73		68		49
7/3	No. 2		4		1		1		6	
7/11			7		0		3		10	
7/18			7		1		6		14	
7/24		6	8	4	3	2	4	12	15	20
8/2		12	20	7	4	16	17	35	41	15
8/8		47	173	34	111	100	303	181	587	69
Av. % reduction		68		62		64		64		35
7/3	No. 3		3		1		1		5	
7/11			6		0		2		8	
7/18			7		3		4		14	
7/24		11	21	4	7	4	7	19	35	46
8/2		8	13	3	10	4	10	15	33	54
8/8		53	361	78	306	123	1052	254	1719	85
Av. % reduction		82		74		88		84		62
7/3	No. 4		2		0		1		3	
7/11			7		0		4		11	
7/18			5		1		6		12	
7/24		30	38	86	124	45	60	161	222	27
8/2		41	72	25	46	52	74	118	192	38
8/7		202	790	236	662	536	2774	974	4226	77
Av. % reduction		70		58		78		73		47
Av. % reduction at all four farms		71		63		79		74		48

TABLE 34

Leafroll Control Experiment—Early Harvest Yield of Potatoes at Four Farms Following Derris Spray or Dust Applications Houlton, Maine, 1944

(Potatoes dug from August 29 to September 9.)

Farm	Yield of potatoes in barrels per acre under indicated conditions						Per cent increase in yield of derris plots over checks		
	Derris treated			Check					
	Vines pulled	Vines killed	Av.	Vines pulled	Vines killed	Av.	Vines pulled	Vines killed	Av.
No. 1	51	43	47	36	40	38	42	7.5	24
No. 2	29	36	32	25	29	27	19	24	22
No. 3	75	73	74	66	63	64	14	16	15
No. 4[1]	69		69	61		61	—		13
Average							25	15	17

[1] At Farm No. 4 tubers from "vines pulled" and "vines killed" plots were weighed together.

TABLE 35

Leafroll Control Experiment—Leafroll in Next Generation Foliage from Tubers from Four Farms Following Derris Spray or Dust Applications Houlton, Maine, and Florida, 1944-1945

Farm	Percentage of leafroll in next generation foliage					
	Early harvest				Late harvest	
	Derris treated		Check		Derris treated	Check
	Vines pulled	Vines killed	Vines pulled	Vines killed		
No. 1	16.8	36.1	7.3	18.9	59.0	40.0
No. 2	0	0.9	0	2.6	51.9	31.1
No. 3	10.1	25.2	17.9	23.4	32.4	47.6
No. 4	2.7	7.4	0	9.9	25.5	20.0
Average	7.4	17.4	6.3	13.7	42.2	34.7

TABLE 36

Comparison of Insecticides Experiment—Yield of Potatoes Following Five Applications to Small Plots with a Hand Duster Houlton, Maine, 1944

(Potatoes dug September 30. Check plots not included in analysis.)

Treatment	Av. lbs. of potatoes from 38 ft. of row in indicated block						Total pounds	Average pounds	Barrels per acre	Per cent increase over checks
	1	2	3	4	5	6				
10% DDT	54	66	68	70	68	83	409	68	174	78
3% DDT	50	63	70	61	56	72	372	62	158	61
0.75% rotenone	50	61	61	55	56	58	341	57	145	48

TABLE 37

Summary by Varieties in the 1941-1942-1943-1944 Florida Test Expressed on a Percentage Basis

Variety	Acreage entered				Not recommended for planting[1] Percentage				Recommended for table stock seed[2] Percentage				Recommended for planting for certification[3] Percentage			
	1941	1942	1943	1944	1941	1942	1943	1944	1941	1942	1943	1944	1941	1942	1943	1944
Bliss	78.	43.	38.	55.4	11	26	None	47	66	74	48	53	23	None	52	None
Chippewa	484.8	796.5	1646.7	3600.	40	67	23	78	43	21	43	15	17	12	34	7
Earlaine #2	4.4	12.	0.0	64.	None	None	None	100	None	All	None	None	All	None	None	None
Gr. Mt.	2008.7	1578.	1914.6	2500.	18	10	9	33	46	54	46	35	36	36	45	32
Houma	136.	68.5	24.	17.	None	None	None	13	10	66	None	59	90	44	All	18
I. Cobbler	1260.9	1510.8	1915.5	2150.	9	25	6	45	47	56	30	37	44	19	64	18
Katahdin	763.5	1009.4	1465.	1475.	None	3	None	11	17	14	11	42	83	83	89	47
Pontiac	1	9.	0.0	0.1	None	None	None	None	None	None	None	None	All	All	None	All
Russett	0.0	16.	18.5	3.	None	None	91	None	None	All	None	100	None	None	9	None
Sebago	274.3	513.1	692.	945.	1	7	1	36	37	35	15	48	62	58	84	16
Sequoia	0.0	22.5	63.6	60.	None	None	20	92	None	89	63	3	None	11	17	5
Warba	12.	6.	8.	9.	None	None	All	100	All	All	All	None	None	None	None	None
Mesaba	0	—	1.5	0.0	None	None	None	None	None	None	None	None	None	None	All	None
Mohawk	—	—	—	6.3	None	None	None	10	None	None	None	24	None	None	All	66
Sp. Rose		—	—	1	None	None	None	None	None	None	None	None	None	None	None	None
Early Rose	—	—	.1	.1	None	None	None	All	None	None	None	None	None	None	None	None

[1] Leafroll reading 2% or less.
[2] Leafroll reading 2.1% to 10%.
[3] Leafroll reading 10.1% or over.

TABLE 38

Summary of Number of Lots of Seed Tested in Florida
1941-1942-1943-1944

Variety	Number of lots tested				Number of lots not recommended for seed stock[1]				Number of lots recommended for growing								Percentage qualifying as foundation seed in	
									Table stock[2]				Certified seed[3]					
	1941	1942	1943	1944	1941	1942	1943	1944	1941	1942	1943	1944	1941	1942	1943	1944	1943	1944
Bliss	7	4	4	6	2	2	0	3	3	2	1	3	2	0	3	0	75	0.0
Chippewa	33	57	142	314	7	29	20	228	16	15	56	49	10	13	66	37	46	12
Earlaine #2	1	1	0	3	0	0	—	3	0	1	—	0	1	0	—	—	—	0.0
Gr. Mt.	129	94	137	199	20	12	11	81	60	35	46	58	49	47	80	67	60	33
Houma	31	10	1	4	0	0	0	1	2	3	0	1	29	7	1	2	100	50
I. Cobbler	77	89	120	188	11	19	3	70	30	42	42	54	36	28	75	51	62	28
Katahdin	71	83	109	133	4	1	0	16	7	15	8	50	60	67	101	67	92	51
Pontiac	1	1	0	1	0	0	—	—	0	0	—	0	1	1	—	1	—	100
Russett	0	2	4	2	0	0	2	—	0	0	—	1	0	0	2	2	50	0.0
Sebago	44	55	81	90	2	2	1	23	13	15	12	32	29	38	68	25	83	27
Sequoia	0	6	8	7	0	0	1	5	0	4	5	1	0	2	2	1	25	14
Warba	2	1	1	1	0	0	0	—	2	1	1	0	0	0	0	0	0.0	0.0
Mohawk	—	—	1	21	—	—	0	3	—	—	—	5	—	—	1	13	100	61
Sp. Rose	—	—	0	1	—	—	—	1	—	—	—	0	—	—	—	—	—	0.0
Mesaba	—	—	1	0	—	—	0	—	—	—	0	—	0	0	1	0	100	—
Early Rose	—	—	—	1	—	—	—	—	—	—	—	1	—	—	—	0	—	—

[1] More than 10 per cent leafroll.
[2] Not more than 10 per cent leafroll.
[3] Not more than 2 per cent total virus.

TABLE 39

Summary of Acreage Represented in Florida Test
1941-1942-1943-1944

Variety	Acreage represented				Not recommended for planting[1]				Recommended as table stock seed[2]				Recommended for planting for certification[3]			
	1941	1942	1943	1944	1941	1942	1943	1944	1941	1942	1943	1944	1941	1942	1943	1944
Bliss	78	43	38	55.4	8.5	11	0	28.3	51.5	32.0	18.0	27.1	18	0.0	20.0	0.0
Chippewa	484.8	796.5	1646.7	3600	191	530.4	381.5	2821.0	209.3	169.6	710.4	516.3	84.5	96.5	551.8	262.7
Earlaine #2	1.4	12	0	64	0	0	0	0.0	0	12.0	0	0.0	4.4	0	-	0.0
Gr. Mt.	2008.7	1578	1914.6	2500	358.9	163.5	181.4	945.8	932.0	851.5	887.2	747.7	717.7	563.0	846.0	806.5
Houma	136	68.5	24	17	0	0	0	4.0	13.5	38.5	0	10.0	122.5	30.0	24.0	3.0
I. Cobbler	1230.9	1510.8	1915.5	2150	116.6	382.5	17	1050.3	592.5	840.5	797.0	714.2	551.8	287.8	1111.5	385.5
Katahdin	763.5	1009.4	1465	1475	0	28	0	182.9	132.5	137.7	163.3	599.4	631.0	843.7	1303.7	692.7
Pontiac	1	9	0	0.1	0	0	0	0	0	0	0	0.0	1.0	9.0	0	0.1
Russett	0	16	18.5	3	0	0	17	0	0	16.0	0	3.0	0	0	1.5	0.0
Sebago	274.3	513.1	692	945	3.3	32	7	379.9	100.0	183.5	111.0	413.0	171.0	297.6	574.9	152.1
Sequoia	0	22.5	63.6	60	0	0	13	55.0	0	20	40.6	2.0	0	2.5	10.0	3.0
Warba	12	6	8	9	0	0	0	9.0	12	6	8	0.0	0	0	0	0.0
Mesaba	0	0	1.5	0	0	0	0	0	0	0	0	0.0	0	0	1.5	0.0
Mohawk	—	—		6.3	0	0	0	0.2	0	0	0	1.5	0	0	0.5	4.6
Sp. Rose	—	—		1	0	0	0	1	0	0	0	0	0	0	0	0.0
Early Rose	—	—	.1	.1	0	0	0	.1	0	0	0	.1	0	0	0	0.0

[1] More than 10 per cent leafroll.
[2] Not more than 10 per cent leafroll.
[3] Not more than 2 per cent leafroll.

TABLE 40

Development of Late-Blight Rot in Green Mountain Potatoes Stored at Different Temperatures in 1944

Temperature of bin	Late-blight rot developing in storage[1]	
	Experiment[2] 1	Experiment[3] 2
Degrees F.	Per cent	Per cent
36	1.9	Trace
40	14.0	11.1
50	42.1	34.8
60	41.7	37.6
70	44.2	41.6
Commercial storage	34.4	41.4
Least required for significance at 1% level	6.06	5.96
Least required for significance at 5% level	4.52	4.45

[1] Average of ten, replicated 50-pound samples for each percentage figure given.
[2] Harvested and placed in storage September 10, 1944.
[3] Harvested and placed in storage September 19, 1944.

TABLE 41

Late-Blight Rot Developing in Potatoes Subjected to High Temperature Treatments

Experiment	Time elapsing before heat treatment applied[1]	Temperature of treatment[2]	Late-blight rot developing in storage[3]
			Per cent
1	None	100-102° F. during day. Dropped to 85° F. during night	26.5
	24 hours	do.	38.6
	48 hours	do.	43.4
Control	—	45° F. – 50° F. (Commercial storage)	37.8
2	None	102-104° F.	16.8
	24 hours	do.	30.1
	48 hours	do.	35.2
Control	—	45° F. – 50° F. (Commercial storage)	42.7

[1] Tubers were harvested and brought to the laboratory where the heat treatment was applied. One lot was treated immediately, another after a 24-hour interval, and the other after an interval of 48 hours.
[2] Temperatures obtained in dry heat chambers fluctuated, being cooler during night. Each lot treated for a 24-hour period.
[3] Average of three 50-pound samples for each treatment.

TABLE 42

Yield Comparison of Green Mountain Plots Sprayed with Bordeaux Mixture According to Different Schedules for the Season 1944

Spray schedule	Number applications for season	Yield per acre[1]		Condition of foliage in field	Protective coefficient[2]
		Barrels	Bushels		
					Per cent
Field sprayed at 7- to 10-day intervals for entire season	7[3]	121±2.92	331±8.18	Green No late blight	100
First two applications omitted	5	123±2.53	338±7.20	Trace Late blight early in season[4]	86
Last two applications omitted	5	116±2.53	319±7.01	Trace Late blight, also early blight	72
Two applications omitted at critical periods	5[6]	118±2.72	323±7.20	Trace Late blight	75

[1] Average of 12 replicated 1/100 acre plots for each treatment.
[2] Equal to infective index of full time spray schedule plots (which is 100) divided by infective index of treatment compared using early- and late-blight disease. (Adopted from Horsfall, James G. and John W. Heuberger. Measuring magnitude of a defoliation disease of tomatoes. Phytopath. 32:226-232. 1942.)
[3] The first application was made July 10, last application for the season September 5.
[4] Late blight first noted July 8 which did not spread extensively.
[5] Some leaves dying because of maturity and early-blight infection September 10.
[6] Applications omitted July 19 and August 1 which appeared to be critical for the control of late blight.
No significant differences at the 1 per cent and 5 per cent level between yield rates.

TABLE 43

Comparison of Yield Rate of a Normal and Delayed Spray Program in the Sebago Variety 1944

Fungicide	Yield rate per acre[1]			
	Normal spray program		Delayed spray program	
	Barrels	Bushels	Barrels	Bushels
Bordeaux	111±2.22	305±6.20	115±1.59	316±3.97
Basic copper sulphate	103±3.31	283±8.96	100±1.94	275±6.42
Unsprayed control	107±6.23	294±17.13	107±6.23	294±17.13

[1] Average of 12 replicated 120-foot 1-row plots.

TABLE 44

Summary Yields—Barrels and Bushels Per Acre for Green Mountains Sprayed with Different Fungicides 1944

Fungicide	Formula used	Yield per acre[1]	
		Barrels	Bushels
Bordeaux	10-5-100	122±5.06	336±12.14
Basi cop[2]	5-100	126±3.71	346±11.80
Tri basic copper sulphate[3]	5-100	144±4.65	397±7.75
Copper Compound A[4]	6-100	130±5.39	358±14.16

[1] Yield based on means from four replicated one-row 100-foot plots for each treatment.
[2] Manufactured by Sherwin-Williams Company, Cleveland, Ohio, and said to contain 52 per cent metallic copper.
[3] Supplied by Phelps Dodge Refining Corporation, 40 Wall Street, New York, New York, and said to contain 52 per cent metallic copper.
[4] Supplied by E. I. Du Pont de Nemours and Company, Inc. Technically tetra copper calcium oxychloride.

TABLE 45

Effect of Organic Fungicides on Yield Rate and Control of Late Blight Tuber Decay 1944

Fungicide	Formula	Yield rate[1]		Late blight tuber rot
		Barrels	Bushels	Per cent
Bordeaux control	10-5-100	97±1.91	268± 5.05	0
604[2] (2-3-dichloro naphthoquinone-1-4)	1-100	98±2.47	270± 7.43	1
604[2] plus zinc sulfate	1-1½-100	101±2.20	276± 6.88	1
Fermate[3] (ferric dimethyl dithiocarbamate)	2-100	98±1.65	271± 4.93	2
Fermate[3] and zinc sulfate	2-1½-100	92±3.30	253± 9.36	3
Dithane[4] (disodium ethylene bisdithiocarbamate)	4-100	100±2.47	276± 6.33	4
Basi-cop[5] (Basic-copper sulfate)	5-100	95±3.85	260±10.46	Trace
Basi-cop[5] and zinc sulfate	5-1½-100	92±2.20	252± 5.78	Trace

[1] Based on six, 75 replicated 1-row plots.
[2] Supplied by Naugatuck Chemical Division of U. S. Rubber Company, Naugatuck, Connecticut.
[3] Supplied by E. I. Du Pont de Nemours and Company, Inc., Elizabeth, New Jersey.
[4] Supplied by Rohm and Haas, Philadelphia, Pennsylvania.
[5] Supplied by Sherwin-Williams Company, Cleveland, Ohio.

TABLE 46

Yield Comparison of Green Mountain and Katahdin Plots Sprayed with Bordeaux Mixture Prepared with Different Formulae and Applied with Tractor-Power Machine
1944

Formula	Total copper sulfate used for season	Yield per acre[1]		Protective coefficient[2]	
		Katahdin	Green Mountain	Katahdin	Green Mountain
	Pounds	Barrels	Barrels	Per cent	Per cent
10-10-100	91.0	78.2±1.96	133.6±1.96	100	100
10- 5-100	91.0	82.6±1.51	125.1±1.05	98	100
8-8-100	72.8	80.9±2.11	123.7±1.20	76	93
8-4-100	72.8	88.1±1.36	123.6±1.66	67	89
6-6-100	54.6	87.3±1.81	127.6±1.51	73	89
6-3-100	54.6	90.3±1.21	128.8±0.30	86	92
4-4-100	36.4	87.8±1.05	127.7±2.26	73	81
4-2-100	36.4	86.8±1.66	120.9±2.26	81	83
Unsprayed control	—	92.7±1.92	—	Nearly dead	

[1] Significance is 8.5 barrels at 1% level and 6.4 barrels at the 5% level.
[2] For flea beetle injury calculated by formula of Horsfall and Heuberger expressed as percentage of the index of the 10-10-100 control.

TABLE 47

The Effect on Yield of Spraying Katahdin Potatoes with Rotenone in Combination with Basic Copper Sulfate

Treatment	Formula used	Yield per acre[1]		Increase or decrease		
		Barrels	Bushels	Barrels	Bushels	Protective coefficient[3]
						Per cent
Basic copper sulfate	5-100	113±2.07	312±11.92	—	—	100
Basic copper sulfate with rotenone[2]	5-4-100	128±1.75	352± 4.93	+15	+40	101
Unsprayed control	—	83±5.28	229±14.59	—30	—83	Plants dead

[1] Average of 18 replicated 120-foot one-row plots for each treatment.
[2] Rotenone applied at the rate of 4 pounds ground Derris Root containing 4.8 per cent rotenone in 100 gallons of water. Plots received seven spray applications for the season at the rate of approximately 135 gallons per acre.
[3] Significance at 1% level is 8.4 barrels or 23.1 bushels.
Significance at 5% level is 3.3 barrels or 9.1 bushels.

TABLE 48

The Effect on Yield Rate, Early Blight Infection, and Flea Beetle Injury from Spraying Green Mountain Potatoes with Copper Fungicides and with Combinations of These Fungicides with Rotenone. Rotenone Alone and with Zinc Sulfate also Included
1944

Fungicide	Formula used	Yield rate per acre[1]		Protective Coefficient[2]			
				Early blight		Flea beetle injury	
		Without rotenone	With rotenone[3]	Without rotenone	With rotenone	Without rotenone	With rotenone
		Barrels	Barrels	Per cent	Per cent	Per cent	Per cent
Bordeaux	10-5-100	126±3.10	122±2.86	100	111	100	100
Basic-copper sulfate	5-100	127±2.24	130±3.82	87	98	85	93
Rotenone	4-100	—	111±1.80	—	52	—	74
Rotenone and zinc sulfate	4-1½-100	—	—	—	52	—	65
Unsprayed control	—	98±1.12	—	—	48	27	—

[1] Based on average of nine replicated single row plots, each 100 feet long for each treatment.
[2] Adopted from method of Horsfall, James G. and John W. Heuberger. Measuring magnitude of a defoliation disease of tomatoes. Phytopath. 32:226-232. 1942. Bordeaux used as the control and has a Protective Coefficient of 100 per cent for these data.
[3] Rotenone applied at rate of four pounds of Derris Root containing 4.8 per cent rotenone in 100 gallons of water.

TABLE 49

The Effect on Yield of Spraying Green Mountain Potatoes with Basic Copper Sulfate and with a Combination of This Material with "Spray Kast" [1]
1944

Fungicide	Formula used	Yield per acre[2]	
		Barrels	Bushels
Basic copper sulfate	5-100	128±2.36	352±9.10
Basic copper sulfate and Spray Kast	5-6-100	123±3.37	338±8.43

[1] Supplied by Woburn Chemical Corp., Harrison, New Jersey.
[2] Based on average of four replicated 100-foot single row plots for each treatment.

Note. There appeared to be no obvious difference in the condition of the foliage comparing the two treatments.

TABLE 50

The Effect on Yield of Spraying Green Mountain Potatoes with Basic Copper Sulfate and this Material in Combination with Soy Bean Oil

Fungicide	Formula used	Yield per acre[1]	
		Barrels	Bushels
Basic copper sulfate	5-100	149±4.05	408±7.39
Basic copper sulfate and oil, and emulsified[2]	5-1-100	150±2.86	413±9.70

[1] Based on average yield of seven replicated 92-foot one-row plots for each treatment.
[2] Made to contain five pounds basic copper sulfate, one quart Soya Bean oil and 1 pint Santomerse (detergent) in 100 gallons of water.

TABLE 51

Yield Comparison of Puratized N5-X and Basic Copper Sulfate Sprayed onto the Green Mountain Variety[1]
1944

Fungicide	Formula used	Yield per acre[2]	
		Barrels	Bushels
Basic copper sulfate	5-100	128±2.36	352±9.10
Puratized N5-X	1-1000[3]	126±3.03	347±6.07
Puratized N5-X	2-1000[4]	115±1.69	316±6.07

[1] Puratized N5-X supplied by Puratized, Inc., 250 East 43rd St., N. Y., N. Y., said to contain 11.6 per cent toxicant.
[2] Yield average of four replicated 100-foot single row plots for each treatment.
[3] 1 part in 1000 parts of water is dilution of 1 to 8620.
[4] 2 parts by volume in 1000 parts of water is dilution of 1 to 17240.

Note. The plots sprayed with Puratized N5-X appeared inferior to those sprayed with Basic copper sulfate.

TABLE 52

Results of Inarch Grafting Plants from Purple Top Sebago Tubers into Healthy Katahdin Plants

Lot No.	No. of grafts	No. grafts producing weak sprouts[1]			Symptoms resulting from grafts[2]
		Grafts	Diseased controls	Healthy controls	
1	16	9	13	0	No current seasonal purple top. Three grafts possibly apical leafroll
2	6	6	6	1	No current seasonal purple top. Two grafts seem to be apical leafroll
3	18	15	17	0	No current seasonal purple top. All plants appear to be normal

[1] The tubers were examined the following spring and the character of the sprouts observed.
[2] Current seasonal symptoms in 1943 and symptoms of plants produced by the tubers that were planted in 1944.

TABLE 53

Yield Rate from Seed Stocks that Have Recovered from Purple Top

Seed lot	Variety	Source of seed stock[1]	Yield per acre[2]		Loss or Increase	Odds
			Barrels	Bushels	Barrels	
1	Sebago	Purple top plants selected 1941	127±2.31	348±6.77	+3	1.00 to 1.00
2		Purple top plants selected 1942. Progeny from wilted tubers	129±3.46	355±8.76	+5	1.18 to 1.00
3		Purple top plants selected 1942. Progeny from medium soft tubers[3]	122±3.20	335±8.00	—2	1.00 to 1.00
4		Purple top plants selected 1942. Progeny from firm tubers[3]	115±3.29	315±9.55	—9	4.64 to 1.00
5		Healthy controls	124±2.99	340±8.41	—	—
6	Katahdin	Purple top plants selected 1942. Progeny from soft tubers	121±2.30	332±7.70	+21	19230 to 1.00
7		Purple top plants selected 1942. Progeny from hard tubers	109±3.14	299±8.51	+9	8.48 to 1.00
8		Healthy controls	100±2.05	275±4.33	—	—

[1] Hills having purple top were harvested in 1941 and 1942 and were perpetuated in the field each year until 1944 when they were used for these yield studies.
[2] Based on 18 replicated 4-hill plots for each yield rate given.
[3] Seed stocks had 14 per cent leafroll which might have depressed the yield rate.

Note: Check Katahdin 98% healthy
PT 1942 (hard tubers) 84% healthy
PT 1942 (soft tubers) 93% healthy

Check Sebago 98% healthy
PT 1941 93% healthy
PT 1942 (hard) 86% healthy
PT 1942 (medium) 83% healthy
PT 1942 (soft) 95% healthy

TABLE 54

Development of Purple Top in Katahdin and Sebago Plants Grown from Seed Stocks that Have Recovered from the Disease

Lot No.	Variety	Year selected as purple top[1]	Kind of seed pieces planted	No. plants in test	Purple Top Developing in plants[2]
					Per cent
1	Katahdin	1941	Whole tubers	25	4.0
2		1941	Cut tubers	25	0.0
3		1942	Whole tubers	100	0.0 (2?)[3]
4		1942	Cut tubers	100	0.0
5		Healthy controls	Cut tubers	125	1.6 (1.6?)[3]
6	Sebago	1941	Whole tubers	25	4.0
7			Cut tubers	25	4.0
8		1942	Whole tubers	75	1.3 (6.6?)[3]
9			Cut tubers	75	1.3 (2.6?)[3]
10		Healthy controls	Cut tubers	75	1.3 (1.3?)[3]

[1] Indicates year the seed stock was selected as being purple top.
[2] Purple top developing in field in plants from seed stocks previously infected with purple top.
[3] Plants that possibly had purple top but diagnosis not definite.

TABLE 55

Comparison of the Number of Aphids on Leaflets from Healthy and Purple Top Plants

Position on plant	Average number of aphids[1] per leaflet		Ratio Number Aphid Healthy vs. Purple Top
	Healthy plants	Purple Top plants	
Top	33.0	73.0	2.2:1
Middle	26.0	80.0	3.1:1
Bottom	39.0	89.0	2.3:1
Average	32.7	80.6	2.5:1

[1] The dominant aphid species was *Macrosiphum solanifolii* Ashmead. Large numbers of *Aphis abbreviata* Patch, were present on isolated plants. *Myzus persicae* Sulzer and *M. pseudosolani* Theobald, were present in smaller numbers. Data based on counts from 22 healthy and diseased plants.

TABLE 56

Acid Mercuric Chloride Used in Dipping Seed Potatoes at Aroostook Farm, 1944—5-Minute Dip

Description of sample	Acid per cent	Mercuric Chloride per cent
	Hydrochloric	
Sample taken before dipping	.04	.1739
Sample taken after 5th dipping	.03	.1639
Sample taken after 10th dipping	.03	.1602
	Acetic	
Sample taken before dipping	.56	.1760
Sample taken after 5th dipping	.55	.1743
Sample taken after 10th dipping	.54	.1741

TABLE 57

Acid Mercuric Chloride Used in Dipping Seed Potatoes at Aroostook Farm, 1944—Acetic Acid 90-Minute Dip and Standard Dip

Description of sample	Acetic acid per cent	Mercuric Chloride per cent
Acidified		
Sample taken before dipping	.53	.0905
Sample taken after 5th dipping	.51	.0901
Sample taken after 10th dipping	.49	.0876
Sample taken after 15th dipping	.48	.0848
Sample taken after 20th dipping	.47	.0819
Sample taken after 25th dipping	.47	.0804
Standard		
Sample taken before dipping		.0832
Sample taken after 5th dipping		.0739
Sample taken after 10th dpiping		.0662
Sample taken after 15th dipping		.0594
Sample taken after 20th dipping		.0483
Sample taken after 25th dipping		.0494

TABLE 58

Early Harvesting as a Means of Controlling Leafroll in Foundation Seed Plots 1942-1944

Variety	No. of Plots Early Harvested			No. of Plots Late Harvested			Average per cent of L.R. in plots early harvested			Average per cent of L.R. in plots late harvested		
	1942	1943	1944	1942	1943	1944	1942	1943	1944	1942	1943	1944
Bliss Triumph	0	1	0	0	0	0	0	0.0	0.0	—	—	—
Chippewa	6	11	12	2	2	8	.35	.14	.3	7.1	.8	4.8
Green Mountain	7	14	11	14	11	16	.1	.08	.4	1.2	.9	4.2
Irish Cobbler	6	10	14	7	5	7	.23	.1	.4	1.07	.4	1.9
Sebago	8	8	4	12	9	9	.07	.12	.5	.77	.5	6.3
Katahdin	8	7	4	7	10	8	.18	.04	.2	.32	.5	.7
Houma	3	0.0	1	4	0.0	1	0.0	0.0	.5	.9	0.0	—
Mohawk	—	—	10	—	—	8	—	—	.49	—	—	10.7

TABLE 59

Total Acreage by Variety and Number of Lots Entered in the Foundation Seed Program and Qualifying as Foundation Seed 1942-1944

Variety	Acreage qualifying as foundation seed[1]			Number of lots qualifying		
	1942	1943	1944	1942	1943	1944
Bliss Triumph	None	2	None entered	None entered	1	None entered
Chippewa	13.7	24.4	25.2	8	10	11
Sebago	49.5	43.4	19.	19	17	7
Katahdin	31.2	40.75	21.7	15	16	9
Green Mountain	45.1	71.	73.2	16	20	15
Irish Cobbler	21.5	38.	79.7	12	15	19
Houma	7.3	.5	.5	7	None entered	1
Sequoia	1	.75	None	1	0	None
Mohawk	—	—	4.2	—	—	12

[1] 2 per cent or less total virus.

TABLE 60

Relation of pH and Replaceable Calcium and Potassium to Potato Scab and Potato Yield

Number of plots	pH range	Replaceable calcium lb. per acre	Replaceable potassium lb. per acre	Scab index	Acre yield barrels
38	4.08 – 5.41	1313	400	0	151
20	4.52 – 5.53	2458	394	0.1 – 5.0	149
19	5.35 – 6.01	2778	477	5.1 – 25.0	153
23	5.65 – 6.28	3084	509	25.1 and over	149

Each plot consisted of two square rods (six 33-foot rows).
Scab index is a weighted average indicating the portion in per cent of the surface area of tubers covered with scab lesions.

TABLE 61

Potato Yields as Affected by Size of Whole and Cut Seed—Maine—1944

Planted May 30, 1944 Harvested October 13, 1944

Treatment No.	Size of tubers used as seed		Average weight of seed piece				Acre yield in bushels			All varieties	
			G.M.	Kat.	Seb.	All varieties	G.M.	Kat.	Seb.	Bushels	Barrels
			oz.	oz.	oz.	oz.					
1	1"–1¼"	Whole	.50	.52	.61	.54	292	271	281	281	102
2	1¼"–1½"	Whole	.88	1.00	.94	.94	317	286	356	320	116
3	1½"–1 11/16"	Whole	1.36	1.42	1.38	1.39	328	317	331	326	118
4	1 11/16"–1⅞"	Whole	1.72	1.81	1.75	1.76	360	302	361	341	124
5	1 11/16"–1⅞"	Split	.91	.88	.91	.90	325	282	306	304	111
6	1⅞"–2½"	Cut	.94	.94	.91	.93	288	271	286	282	103
7	1⅞"–2½"	Cut	1.45	1.44	1.41	1.43	332	280	344	319	116
8	1⅞"–2½"	Cut	1.91	1.91	1.94	1.92	358	303	387	349	127
Minimum difference for significance at 5% level										23.2	8.9
at 1% level										30.2	11.0

Size of plot: Single row 24' long 3' apart.
Number of replicates: 6.
Spacing: 9 inches.
Seed source: McNally.

TABLE 62

Effect of Certain Seed Treatments on Number, Size, and Weight of Tubers[1]

Treatment	Tubers less than 1¼" (Culls)		Tubers 1¼"–2⅞"		Tubers over 2⅞"		Total No. of tubers	Total wt. of tubers	No. of stems per hill
	No. of tubers	Wt. in lbs.	No. of tubers	Wt. in lbs.	No. of tubers	Wt. in lbs.			
8 inch spacing	58	1.2	186	35.8	3	1.5	247	38.5	2.4
10 inch spacing	53	1.1	172	34.3	3	1.7	228	37.1	2.3
12 inch spacing (control)	28	.6	134	27.7	7	4.3	169	32.6	2.3
Transplantone[2]	47	.9	158	31.3	3	1.8	208	34.0	2.7
Indole acetic acid[3]	28	.6	136	29.1	6	3.6	170	33.3	2.2
Ethylene chlorohydrin[4]	37	.8	151	29.1	4	2.1	192	32.0	2.4
Thiourea[5]	44	.9	161	30.2	4	2.2	209	33.3	3.3
Thiourea[6]	51	1.0	152	29.9	2	1.4	205	32.3	2.8
Thiourea[7]	42	.8	158	28.7	2	1.1	202	30.6	2.8
Minimum difference for significance at									
5% level	12	.3	16	2.8		1.4	22	3.0	
1% level	16	.4	22	3.7		1.9	29	4.0	

[1] Yields based on average of six 25 ft. row replicates per treatment.
[2] Cut seed pieces soaked 24 hrs. in solution, 1 oz. to 10 gal. Transplantone is a patented product composed of several vitamins and growth substances.
[3] Cut pieces soaked 1 hr. in .01% solution.
[4] Whole tubers exposed to vapor of 1 c.c. of anhydrous chemical per kilogram of seed in a closed container for 24 hrs.
[5] Cut pieces soaked in 1% solution for 1 hr.
[6] Whole tubers soaked in 1% solution for 1 hr.
[7] Whole tubers soaked in 2% solution for 1 hr.

TABLE 63

Experimental Potatoes Grown at Aroostook Farm in 1944—R. Akeley

Date	Stake No.	Variety	Starch by balance %	Wt. 5 kg. in w.	Water displ.	Sp. g.	No. to 5 kg.	Total solids
10/11	1	627-103	13.70	365	4575	1.0787	35	21.6
10/11	2	47156	13.95	370	4275	1.0799	25	22.45
10/5	3	Mohawk	14.45	380	4550	1.0823	25	22.15
10/5	4	Pontiac	10.95	310	—	1.0661	23	19.1
10/5	5	Katahdin	12.45	340	4250	1.0730	25	19.5
10/11	6	Menomonie	12.05	332	4475	1.0711	18	20.4
10/11	7	Erie	12.85	348	4550	1.0748	35	20.6
10/6	8	Earlaine #2	10.10	293	4550	1.0622	29	17.15
10/26	9	47258	12.65	344	4750	1.0739	30	19.25
10/25	10	Rural New Yorker	14.20	375	4300	1.0811	34	22.5
10/11	11	Pawnee	13.10	353	4650	1.0760	37	21.25
10/6	12	Sebago	11.05	312	4650	1.0666	26	19.65
10/3	14	Sequoia	12.20	335	4200	1.0718	28	20.6
10/26	15	Chippewa	11.35	318	4675	1.0679	33	19.55
10/19	16	47102	11.70	325	4125	1.0695	26	19.05
10/6	17	Green Mountain	14.55	382	4550	1.0827	28	21.55
10/18	18	627-126	14.00	371	4550	1.0804	48	21.3
10/18	19	47402	11.70	325	4625	1.0695	28	20.2
10/18	20	Calpride	12.30	337	4450	1.0723	27	19.4
10/17	21	White Rose	12.10	333	4625	1.0714	22	18.5
10/17	22	47194	11.55	322	4575	1.0688	27	19.45
10/25	23	47148	13.05	352	4250	1.0757	22	21.8
10/25	24	Russet Burbank	13.60	363	4650	1.0783	32	20.55
10/17	25	47528	10.55	302	4550	1.0643	24	19.2
10/21	151	Red Warba	14.35	378	4450	1.0818	40	22.4
11/8	152	96-56	13.60	363	—	1.0783	28	20.0
11/15	153	De Soto	13.70	365[1]	—	1.0787	75	18.75
10/17	155	46952	12.55	342	4250	1.0734	32	20.25
10/17	156	47496	12.05	332	—	1.0711	43	19.4
11/10	158	47499	13.45	360	—	1.0776	30	21.8
11/7	159	47507	12.30	337	—	1.0723	44	19.2
10/21	160	Triumph	13.10	353	4475	1.0760	37	20.55
10/30	161	Mesaba	14.35	378	—	1.0818	35	21.8
11/2	162	96-44	13.60	363	—	1.0783	24	21.6
10/9	163	Chippewa	11.80	327	4600	1.0700	37	19.2
10/9	166	Earlaine	13.10	353	4625	1.0760	39	20.75
11/10	229	B67-11	15.05	392	—	1.0848	—	22.45
10/31	230	B175-7	12.65	344	—	1.0739	32	19.2
10/11	231	Earlaine	12.55	342	4500	1.0734	37	20.1
11/10	232	B 70-5	13.60	363	—	1.0783	25	20.5
10/25	233	B 171-19	11.55	322	4475	1.0688	38	19.05
10/18	234	B 73-10	13.50	361	4600	1.0778	26	20.25
11/9	235	B 235-16	13.30	357	—	1.0769	28	18.45
10/30	236	46952	12.55	342	—	1.0734	36	20.4
11/9	237	B 61-3	13.95	370	—	1.0799	32	20.1
11/10	238	B 66-2	14.05	372	—	1.0804	41	20.55
11/10	239	B 176-5	13.60	363	—	1.0783	36	19.95
11/7	240	B 192-17	12.85	348	—	1.0748	35	19.95
11/8	241	Red Warba	14.05	372	—	1.0804	44	20.85
11/8	243	B 75-4	14.95	390	—	1.0844	34	21.8
11/7	244	B 177-14	13.30	357	—	1.0769	32	20.4
11/8	277	B 69-12	12.20	335	—	1.0718	27	19.15
10/19	278	B 194-13	10.55	302	4625	1.0643	25	17.45
11/10	279	B 73-2	12.95	350	—	1.0753	25	19.25
10/30	280	B 188-9	13.80	367	—	1.0792	27	21.4
10/3	281	Mohawk	14.55	382	4000	1.0827	24	20.55
10/3	282	Katahdin	12.10	333	4175	1.0714	28	18.65
10/30	283	X 815-20	12.95	350	—	1.0753	32	20.1
10/28	284	Chippewa	11.05	312	—	1.0666	30	17.2
10/31	285	B 174-5	11.05	312	—	1.0666	26	18.15
11/10	286	B 73-18	14.35	378	—	1.0818	21	21.55
10/19	287	B 189-14	14.85	388	4500	1.0841	30	24.15
10/19	288	B 188-69	13.80	367	4475	1.0792	29	21.65
11/15	289	X 815-17	10.45	300	—	1.0638	28	18.6
10/19	290	B 188-61	13.05	352	4650	1.0757	26	20.0
10/3	291	Green Mountain	14.70	385	4000	1.0834	28	22.25
10/3	292	Sebago	12.45	340	4200	1.0730	28	21.05

TABLE 64

Experimental Potatoes—Presque Isle Farm (Akeley)
Named Domestic Varieties—1944 Crop

Variety	Starch by balance %	No. to 5 kg.	Weight 5 kg. (11#) in water g.	Total solids experi-mental	Total solids Foth Table 1907	Difference
Earlaine #2	10.10	29	293	16.60	15.90	0.70
Pontiac	10.95	23	310	19.10	16.71	2.39
Chippewa	11.05	30	312	17.20	16.81	0.39
Sebago	11.05	26	312	19.65	16.81	2.74
Chippewa	11.35	33	318	18.55	17.10	2.45
Chippewa	11.80	37	327	19.20	17.54	0.66
Menomonie	12.05	18	332	20.40	17.80	2.60
Katahdin	12.10	28	333	18.65	17.85	0.80
White Rose	12.10	22	333	18.50	17.85	0.65
Sequoia	12.20	28	335	20.60	17.93	2.67
Calpride	12.30	27	337	19.40	18.03	1.37
Sebago	12.45	28	340	20.60	18.19	2.41
Katahdin	12.45	25	340	19.50	17.85	1.31
Earlaine	12.55	37	342	20.10	18.29	1.81
Erie	12.85	35	348	20.60	18.57	2.03
Earlaine	13.10	39	353	20.75	18.83	1.92
Pawnee	13.10	37	353	21.25	18.83	2.42
Triumph	13.10	37	353	20.55	18.83	1.72
Russet Burbank	13.60	32	363	20.55	19.32	1.13
De Sota	13.70	75	365	18.75	19.41	−0.66
Red Warba	14.05	44	372	20.85	19.77	1.08
Rural New Yorker	14.20	34	375	22.50	19.92	2.58
Mesaba	14.35	35	378	21.80	20.07	1.73
Red Warba	14.35	40	378	22.40	20.07	2.33
Mohawk	14.45	25	380	22.15	20.10	1.99
Mohawk	14.55	24	382	21.55	20.26	1.29
Green Mountain	14.55	28	382	21.55	20.26	1.29
Green Mountain	14.70	28	385	22.25	20.41	1.84

TABLE 65

Average Loss in Weight of Potatoes Stored at 32°, 36°, and 50° F. Over a Period of 7 Months

Loss by Variety		Loss by Month		Loss by Temperature	
Variety	Average % loss in 7 months at 32°, 36°, 50° F.	Months	Average % loss in 6 varieties at 3 temperatures	Temperature	Average % loss of 6 varieties over 7 months
Katahdin	4.3	1	2.5	32° F.	7.0
Cobbler	4.3	2	3.9		
Chippewa	5.3	3	4.3	36° F.	4.6
Mohawk	6.0	4	4.9		
Green Mountain	6.5	5	6.2	50° F.	6.0
Sebago	8.7	6	9.3		
		7	9.9		

Average Per Cent Loss During 7 Months Storage at All Temperatures

Variety	32° F.	36° F.	50° F.	60° F.	70° F.
Katahdin	5.4	3.0	4.5	12.5	12.8
Cobbler	4.6	3.2	5.2	14.2	13.9
Chippewa	5.6	4.0	6.4	16.5	15.5
Mohawk	7.8	5.0	5.2	9.2	10.5
Green Mountain	8.0	5.1	6.4	14 9	16 5
Sebago	10.5	7.2	8.4	20.3	19.5

General view of one of the Katahdin plots subjected to a high level of aphid population. Randomized block, population-levels experiment. Aroostook Farm, Presque Isle, Maine. September 11 or 16, 1944. W. A. Shands.